Fishers should be encouraged to collect data. Lots of it!

Using tablet-based technologies to collect data in commercial and recreational fisheries

A report for

By Tom Robinson

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Executive Summary

In a world where the general population relies so heavily on smartphones and tablets to perform day to day tasks such as banking or checking the weather, the commercial fishing industry has been stubbornly slow to adopt electronic reporting in their businesses.

As a consequence, fishing regulators around the world are forcing industry to move toward electronic reporting, often against their will. In many cases, regulators are reverting to tactics such as charging for paper-based submissions in an attempt to force this change. Even this rather blunt approach has failed to meet its objective, with many operators hanging on to paper for as long as they possibly can.

This report explores the reasons behind this reluctance to embrace the move to electronic reporting, noting that the very fishers who are hanging onto their paper, moved as members of the general public to electronic banking and online bookings years ago.

The reasons behind their decision to avoid reporting electronically are many and varied. Ironically, none are linked to the fishers' belief that there are technical challenges stopping them from making the move, with all those interviewed feeling comfortable that if their banking is secure, their fishing data should be secure at a technical level.

The real insight of this report relates to a perceived risk by the fishers that recording their fine scale data, which is really their intellectual property (IP), is putting their businesses at risk. They are fearful that once data is collected it can be accessed by other stakeholders (principally government agencies) and potentially used against them for things like marine parks or quota reductions.

This report demonstrates that if industry started collecting its own data, it would be in a stronger position to have meaningful dialogue with those stakeholders who ultimately manage their fisheries. All stakeholders would benefit from the greater transparency that well managed, secure data could provide, starting from the decision to open the fishery by the regulator, through to the person who ultimately consumes the catch.

Can the fishing industry continue to hide its data because of a perceived risk of the government using it against them? Or, does industry and the fisheries regulator, need to get smarter about how they use data to sustainably manage fisheries into the future.

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Foreword

At age 32, I made a literal sea change. I quit my career in advertising, my wife quit her job as a lawyer, and we sold up everything to purchase the lowest cost commercial fishing licence we could afford. On November 1, 2002 we incorporated Coorong Cockles Pty Ltd and I became a fisherman. Well, sort of… My Nuffield research topic focussed on two industries in which I have direct involvement.

Firstly, I entered the Lakes and Coorong Pipi fishery in 2002 only to discover I wasn't particularly good at fishing! I quickly needed to find a role for myself or my dream of being part of the fishing industry was going to be over before it began. Fortunately, for reasons only they will ever understand, the other fishers decided to support me rather than alienate the new guy who was unlike any fisher they'd ever met. It took 12 years for us to build trust in each other, but after some small wins gained by working as a team instead of individuals, we started to transform the humble Pipi from a bait product to a premium food. The company we collectively formed in 2014, Goolwa PipiCo now represents 65% of the total South Australian Pipi fishery. I thank the Goolwa PipiCo Board and staff for allowing me to step away from the business for 16 weeks to do my scholarship.

Figure 1: Key Persons: Top: Goolwa PipiCo Board and key management staff. Coorong, South Australia, May 2018. And Real Time Data Board and key management staff. Port Elliot, South Australia, January 2019 (Source: Author)

Secondly, in 2013, missing some of the creativity of my previous career and recognising a need for better data in fishing, I teamed up with a former advertising colleague to explore how tablet-based technologies could be used to solve this problem. Our start-up company, Real Time Data has developed an app called Deckhand we hope will deliver on this goal. My Research Topic - Using tablet-based technologies to collect data in commercial and recreational fisheries, changed its focus slightly over the course of my scholarship. It broadened to talk to the more philosophical statement of why Fishers should be encouraged to collect data. Lots of it. For my private study I broke my travel into three distinct parts.

March 2018 - following on from the Contemporary Scholars Conference (CSC) in The Netherlands – I visited Barcelona, primarily to visit the customer who buys our Pipis and to visit the markets that took food displays to levels I'd never seen before. I then travelled to London to see the equally impressive Borough Market and visit the head office of the Marine Stewardship Council (MSC) who certify our Pipi fishery's sustainability credentials.

June / July 2018 - My Global Focus Program (GFP) included Singapore, The Philippines, Japan, Israel, The Netherlands and finished in the United States of America (USA). An amazing experience at a personal and educational level. Probably the highlight of my scholarship, ironically for all the reasons I was dreading it.

In August 2018 I spent a week in New Zealand working closely with the key stakeholders responsible for implementing electronic reporting into the commercial fishing fleet. A big thank you to the team at FishServe and FishServe Innovations New Zealand (FINNZ) who have backed me in personally and for their tremendous support in developing our software.

In October and November 2018, the final leg of my private study started off with me attending the The Food and Agriculture Organization – The Committee on World Food Security Conference (FAO - CFS 45) that was taking place in Rome. My travels then took me to Belgium to meet with key people from the Directorate-General for Maritime Affairs and Fisheries who oversee European fisheries, Cork in Ireland to meet with Bord Iascaigh Mhara (Ireland's seafood development agency) for some great insights into all aspects of fishing in the North Sea and then back to the Netherlands to meet with some fishers introduced to me by Edwin Michiels from my GFP.

My private study finished off with a week in Seattle and British Columbia where I visited some amazing fisheries and learned a lot about electronic reporting. I then spent time on the east coast of the USA highlighted by meetings with the Lobster industry which is looking at electronic reporting for its 5,000+ vessel fleet. A massive thank you to Lange Solberg, a Halibut fisherman with a passion for technology, for helping to organise such a comprehensive schedule of meetings. My last two days of the scholarship were spent in Washington DC where a meeting with the National Oceanic and Atmospheric Administration (NOAA) and dinner with John Connolly from the National Fisheries Institute (NFI) which crystallised everything I had absorbed over the previous 16 weeks.

Finally, a massive thank you to Fisheries Research and Development Corporation (FRDC) for giving me the opportunity to do 'my Nuffield'.

NOTING A CONFLICT OF INTEREST

Clearly it is self-serving to talk about a product that I have a commercial interest in, however ignoring 'the elephant in the room' would make this report largely worthless in that my studies were to explore how tablet-based technologies could help fishers. Having looked at other technologies from around the world it would appear the Deckhand product we are developing (and other tablet-based apps) will fill a market void that hasn't been addressed. The technological step-change required to build these products is still under development. For clarity, Deckhand and the Solar VMS unit that provides the satellite connection are still being finalised at the time of writing this paper.

Acknowledgments

Only the people who sat through my final selection interview in Sydney will know how hard I tried to talk myself out of doing a Nuffield Scholarship. I left the interview completely confused, as I'm sure the panel was. Still not done, I sent the CEO an email as soon as I got back to my hotel further clarifying my apprehensiveness about doing a Nuffield at 50 years.

It was therefore surprising to receive a phone call a fortnight or so later to confirm that I had been successful. Clearly the selection panel and my references they had contacted, had seen something underneath my ramblings to give them the confidence to back me in. For that, I am eternally grateful. My Nuffield experience was not only beyond all my expectations, it taught me things about myself that would never have surfaced without the pressure put on everyone who does the scholarship.

The biggest highlight of my scholarship was the thing I was dreading the most. Spending time with eight other strangers for a six-week GFP. Our group was older than most (average age 40+), incredibly diverse and all very passionate about their respective industries. Thank you to my GFP group, (you know who you are), for an amazing six-week race around the world. Your friendship is my most important take-away from the experience. I look forward to reading all of your reports and catching up with some of you in Brisbane in September 2019.

A massive thank to FRDC for encouraging me for over a decade to put my hat in the Nuffield ring. The support Patrick Hone and his team have given me and the companies I've been involved in over the past 18 years has been nothing short of incredible. Really amazing people.

The longest period I had ever left my family before Nuffield was about two weeks. Thank you to my wife Victoria and two children Harry (19) and Prue (16) for allowing me this indulgence and for holding the fort while I was away. The time I spent with Vic and Prue in Seattle and New York will be something we will never forget. Thank you also to my parents Paul and Miffy who have supported my rather unconventional career path. Your support and care during tough times made it possible for me to get to a point where I could do this scholarship.

Finally, I would like to dedicate this report to my dear friend Andrew Bone who died aged 49 while I was in The Netherlands for the CSC. Much like the Nuffield process, Andrew's greatest strength was bringing together groups of people. He was bigger than politics, never held a grudge and managed to see the good in everyone. I, along with all his mates, will miss him.

Abbreviations

AFMA - Australian Fisheries Management Authority

AIS - Automatic Identification System

API - Application Programming Interface

CDR - Catch Disposal Record

CFS - Committee on World Food Security

CSC - Contemporary Scholars Conference

DEWNR - Department of Environment, Water and Natural Resources

e-Log - electronic logbook

FAO - The Food and Agriculture Organization

FINNZ - FishServe Innovations New Zealand

FRDC - Fisheries Research and Development Corporation

GFP - Global Focus Program

NFI - National Fisheries Institute

NOAA - National Oceanic and Atmospheric Administration

PC - Personal computer

PIRSA - Primary Industries and Regions South Australia

SARDI - South Australian Research and Development Institute

SEPFA - South East Professional Fishermen's Association

SnapIT - Snap Information Technologies Ltd

SRL - Southern Rock Lobster Limited

UAE - United Arab Emirates

USA – United States of America

VMS - Vessel Monitoring System

WH&S - Work Health and Safety

Objectives

The aim of was to explore how the fishing industry, which is so reliant on technology to find its catch, has been puzzlingly so slow to move away from paper-based reporting.

This report hopes to answer the question by interviewing key stakeholders in Australasia, Europe and USA. The objectives are:

- To clarify the role of the regulator in fishing and their need for accurate data.
- To understand the different ways commercial and recreational fishers record their catch and what the data is used for.
- To explore what regulators are doing to get themselves ready for electronic reporting and how they intend to use the data they receive.
- To define what options are available to industry to collect data and what is on the horizon.
- To explore what other benefits can be realised through data by having a device such as a tablet onboard commercial (and recreational) fishing vessels?
- To determine how recreational fishing data can be better managed for the future management of fisheries.

Chapter 1: Introduction

In its 'State of the World Fisheries and Aquaculture Report' (2018), the FAO estimates the global wild catch fishing fleet to be 4.6 million vessels in 2016. Interestingly, the fleet in Asia is estimated to be 3.5 million vessels on its own. Of significance to this report is the fact that only 2.8 million of those vessels are powered by an engine. On the same theme, 86% of the global fishing fleet operated in boats that are less than 12 metres in length.

From the same report it is estimated that since 1961 the annual global growth in fish consumption has been twice as high as population growth. In addition, seafood consumption also exceeded that of meat from all terrestrial animals combined. Clearly there is a need to ensure that fish stocks are correctly managed if we are to continue relying on protein harvested from a wild caught marine resource.

This paper looks specifically at Europe, USA, and New Zealand (as well as most Australian states, noting that this was not part of my official Nuffield study period). These countries were selected on the basis that looking at the total global commercial fishing fleet would be impossible given the timeframe and budget of the project; but probably more importantly it focusses on developed fishing jurisdictions that would, in the short to medium term, have the capacity for the type of technology being examined. Table 1 below shows a summary of these countries and their fishing fleets.

Fleet location and type	Number of vessels	Source
Australian Commercial Fleet	8,924 (2009)	Australian Fisheries and Aquaculture Statistics (2016)
Australian Recreational Fleet	>5 million	Australian Fisheries and Aquaculture Statistics (2016)
New Zealand Commercial Fleet	1,094	Jones, M. (2018)
New Zealand Recreational Fleet	530,549	Ministry for Primary Industries (2014)
European Commercial Fleet	83,734	Eurostat. (2018)
European Recreational Fleet	n/a	n/a
USA Commercial Fleet	36,150	FAO (2016)
USA Saltwater Anglers	8.9 million	Fisheries Economics of the US Report (2015)
USA Freshwater Anglers	30.1 million	US Fish and Wildlife Service (2016)
Canadian Commercial Fleet	17,522	Fisheries and Oceans Canada (2017)
Canadian Recreational Fleet	32.4 million	Fisheries and Oceans Canada (2015)

Table 1: Fleet overview of studied countries (source: above)

This report will largely focus on the commercial fishing fleet as this sector and the regulators and scientists who manage it are already collecting data from fishers. That is not to say that recreational data is not important, in fact this report will highlight the importance of counting all fish that come out of the water, regardless if caught on a commercial or recreational hook.

Chapter 2: Role of government in fishing

As a wild caught resource, the role of government is critical in ensuring fisheries are managed in a sustainable manner. Every jurisdiction is different; however standard fisheries management typically consists of the following government regulatory authorities.

- Policy and regulatory management for wild caught fisheries and aquaculture production
- Licensing and quota management
- Science and research
- Compliance
- The Department for Environment (or other international equivalents) often has a significant input into fisheries policy

Critical to the process is data collected from fishers in either paper or electronic formats.

2.1 A distrust of the authorities who manage the fisheries

Relations between fishers and the governments who regulate the resource they fish are regularly strained. Disagreement between industry and the regulator or science agencies is not uncommon and is further complicated when other stakeholders such as environmental groups join the debate about the best way to manage a wild caught resource. By way of an example, in 2014 the South Australian Government decided to introduce marine parks with the objective of protecting some of the State's iconic marine species. An extensive consultation process was embarked upon, with many fishers providing fine scale catch and effort data to the process with a view to protecting 'their' most productive fishing grounds (Ferguson, G., pers. comm., October 2018).

When the final recommendations for where the marine parks were to be situated was handed down by the Department for Environment, Water and Natural Resources (DEWNR), the industry went into uproar, accusing the government of using the data that they believed had been supplied in good faith to assist in finding an equitable outcome for all parties. Worse, industry also accused government of sharing data previously provided to another government science agency, the South Australian Research and Development Institute (SARDI), who, along with the DEWNR, were determining where the marine parks should be placed, without conducting a proper consultation process with the fishers. In the eyes of industry this set a dangerous precedent and alerted industry to the dangers of having

sensitive data accessible to bodies for whom it was not originally intended (Ferguson, G., pers. comm., October 2018).

There are similar examples of this type of thing happening in other fishing jurisdictions around the world. But importantly, it is a tangible example of how once something is recorded, even if it is for another purpose, it is technically possible to use that data for a purpose it was not originally intended. This is not unique to fishing, there are many other examples of data breaches in other sectors. The recent uproar over medical records being used for purposes other than the one it intended, is just one example (Margo, 2018). As a consequence, most commercial fishers are extremely reluctant to share anything more than their minimum regulatory reporting requirements. For this reason, in some jurisdictions there is constant debate between the regulator and the industry about what constitutes the minimum regulatory reporting requirement (Roger Edwards, pers. comm. December 2018).

2.2 Sending data to be stored offshore may make it harder to access by others

The author had a very insightful meeting with Eibhlin O'Sullivan from EOS Solicitors in Cork, Ireland in October 2018. Eibhlin acts as an in-house lawyer for Verifish, a company that specialises in software for the fishing industry in Ireland. She understood the issues of data security better than anyone and had an interesting insight into the place data is geographically stored. This might also impact on how available it is to anyone wishing the access it. By way of example, Eibhlin's view was that data stored in Switzerland or Singapore is likely to be safer than data stored in Australia. In practical terms, this might mean that a fisher collecting his data in Australian waters, might be better served sending that data to be stored in Switzerland, than in Australia, as the laws protecting data in Switzerland have been proven to be some of the most stringent when tested in law. This would need further professional advice, however there is precedent with companies such as Facebook that have proven Swiss laws surrounding data privacy are stronger than other countries (Brown, B., 2016).

Chapter 3: How do fishers currently report fishing activity?

Before answering the question about how fishers report their catch, it is imperative to understand how they view their data. To a commercial fisher, where they catch their fish is their intellectual property (IP). Knowing how to efficiently catch the fish is the difference between a good operator and an ordinary one. Good fishers spend less time on the water, use less fuel, use less bait, lose less gear and come back with higher value loads and lower expenses. This knowledge doesn't come easily. In many cases it is handed down through generations or only shared with close friends within the fishing community, which is the exception, not the norm.

3.1 How does paper-based reporting work?

Large numbers of fisheries still use paper and the postal system as the primary way to report regulatory fishing data. There are two main forms that exist in fisheries around the world:

1. A Catch Disposal Record (CDR)- The primary purpose of this form is to manage quota-based fisheries. The form serves a number of purposes. Specifically:
    a. it normally requires the fisher to phone a call centre or log onto a website to acquire a unique number. This starts the paper trail for that session and advises compliance (the fisheries police) that the fisher is about to start fishing.
    b. It also links the fishing session and resultant catch to tags by which the fish is counted / weighed.
2. A catch and effort report - This document typically summarises a catch over an allocated period for the purposes of science. It provides greater detail about the catch than the CDR but can be still quite broad in its reporting (PIRSA, 2018).

A common criticism of some catch and effort forms is that fishers might only complete it once a month (i.e. when it is due). So even the data collected in these cases may need to be treated with a grain of salt because if it is filled in up to 60 days after the data was originally recorded, it is unlikely to be accurate.

CDR information is usually more accurate because it needs to be lodged after every fishing event, but most regulators allow another 30 days' grace before fining the fisher for a late return.

Like any paper-based form, there are limitations to the system. The main ones being:

1. They can get 'lost in the mail'.
2. Handwriting is often hard to read, made worse when the paper is wet from a day's fishing. This results in delays as the fisher needs to re-submit the form, or errors as the data entry person wrongly interprets what has been recorded.

The author noted that it is not uncommon for fishing data to have a lag of six months or more caused by issues such as those outlined above. Kathryn Stack (pers. comm., October 2018) of Europeche, the Association of National Organisations of Fishing Enterprises in the European Union, explained that a lot of European fisheries data has a lag of over a year because of (amongst other things) the inefficiencies of accessing the data from the fisher.

To provide context to how prevalent paper-based reporting still is, according to the Australian Fisheries Management Authority (AFMA) and FishServe, all fisheries in Australia and New Zealand, totalling eight different jurisdictions and over 8,000 vessels, still do the majority of their reporting via paper (Andrew Powell, pers. comm., 2018; Jones, M., pers. comm., 2018). Other developed countries visited by the author as part of the scholarship were equally reliant on paper. The author conservatively estimates that paper-based reporting still represents at least 90% of all fisheries reporting.

3.2 Two sets of records

To the background outlined above, the majority of commercial fishers maintain two distinct sets of records.

1. One for the regulator to record the minimum regulatory data.
2. Another private set to record their own intellectual property (IP) about where and how they caught their fish.

3.3 Hanging on to paper-based reporting

Further, there is a strong reluctance from many fishers to 'get off' paper-based reporting because, perhaps naively, they believe that by recording something on paper it helps reduce the risks outlined above. Further, there is a reluctance, particularly from older fishers, to move to something (technology) they are unfamiliar with and they believe will

add another cost to their business. While meeting with Brian O'Riordan, from Life Platform in Belgium (October 2018) his thoughts were: '*Many commercial fishermen would rather continue doing things the way they have always been done - including paper-based reporting. They don't like change, particularly when it is forced on them*.'

3.4 Current electronic reporting options

Companies such as OLSPS Marine and Catchlog have had reporting software available to the global fishing industry for decades. The software runs on personal computers (PCs) which limits their installation to larger vessels with enclosed wheelhouses to protect the electronics. These systems are typically integrated with other on-board systems including Vessel Monitoring Systems (VMS) and sounders to provide visibility in regulatory and non-regulatory data. The cost and complexity of these systems make them suitable to only a small percentage of the global fleet. The FAO estimates that less than 14% of the global fleet is over 12 metres in length, which would be the size of vessel most likely to fit the criteria outlined above (FAO, 2018).

Data from these systems can be sent to the regulator, where electronic data records are received via an Application Programming Interface (API), which would be the same system that data entry staff enter paper-based forms into.

Chapter 4: Governments getting ready for electronic reporting

Recognising that the fishing industry will need to get itself 'off paper', fishing jurisdictions around the world have either introduced 'back-ends' to accept electronic data from fishers or are in the process of exploring their options. A common theme from the jurisdictions the author visited, was limited collaboration between regulatory authorities to find a single solution that would interact with other systems. Australia is a good example of this, where every State has chosen to build its own backend without input from their neighbouring states. Many of those interviewed believed there would be great benefit in a common standard, not to mention the potential cost savings. This observation is not unique to Australia, with European and USA jurisdictions finding it equally difficult to work in a collaborative way (FAO, 2018).

Many jurisdictions are in the process of working out the best approach to collect electronic data from fishers. At a meeting the author had with Megan Ware (November 2018), Fishery Management Plan Co-ordinator, Atlantic States Marine Fisheries Commission, she was very interested to hear about what other countries were doing. Her team were exploring options for electronic reporting that will become mandatory in the Maine Lobster fleet in 2022. She noted that her department was currently searching for the best approach for electronic data collection for that fleet. The team was debating the merits of the government providing a single solution that fishers were forced to use, or to use a similar approach to the one being used in South Australia, where the government would provide the APIs for third party providers such as Deckhand to report to.

4.1 State and Commonwealth government 'back-ends'

An important part of the electronic data story is to understand what each of the States and Commonwealth have done with their back-ends to accept data from industry. Table 2 summarises the state of play at the time of writing.

Jurisdiction	System	Status
South Australia	eCatch	Built 2014
Western Australia	FishEye	Built 2015
Northern Territory	Under development	Timing TBA
Queensland	New camera-based system currently under development	Timing TBA
New South Wales	n/a	n/a
Victoria	Under development	Commences 2019
Tasmania	Early stages of scoping	Timing TBA
Commonwealth (AFMA)	System currently in use, but about to be replaced.	Built early 2000s. About to be re-built.

Table 2: Australian Government back-end summary (source: pers. comm)

4.2 State and Commonwealth government 'front-ends'

If a backend is the component that receives the electronic report from a fisher (via an API), the 'front end' is the device and software that sends the report to the government API. In most cases the government has built a front end, which is usually a web form or similar that fishers can complete and submit. As a generalisation, all of the fishers who have used the government-built interface find them 'clunky' to use and harder than the paper-based forms they were designed to replace.

In the case of the South Australian government they have opened their backend to third party providers such as Deckhand to build frontends that fishers find easier to use. The important difference is that this model requires fishers to make a commercial decision to go with a 'free' government solution, or pay for, in Deckhand's instance, an app that they find easier to use. The author believes that this type of model will be replicated in jurisdictions globally as fishers look for solutions that are more tailored to their specific fishing methods and associated needs.

4.3 Data harmonisation

As outlined above, there was a general sense of agreement with the people interviewed throughout the scholarship that jurisdictions find it hard to think beyond their own backyard when it comes to data. The fallout of this invariably results in 'silos of data' that have negative outcomes for multiple stakeholders. From a technical perspective the utopia is a world where there is a common standard that all stakeholders use. The term 'data harmonisation' is a term universally aimed for, but for the reasons outlined above, is rarely achieved. The benefits of harmonising the data are numerous and significant:

- Data harmonisation would allow scientific agencies to compare their data with others, without the need to re-interpret what had been recorded by the other party.
- If a common data standard was adopted by the fishing industry, software and hardware developers would be more inclined to invest in development. This is because their product would be able to be sold to a much larger customer base, who all spoke the same technical language.
- Fishers would benefit from an increased number of software and hardware providers offering products to their sector. Data harmonisation would allow fishers to swap from one software provider to another in the same way you can move telecommunication services overnight if you are unhappy with your current provider. '*Fishers should be able to move all their historical data from one software provider to another, in the same way they can keep their phone number and contact list from the phone handset'*. (Dennis Holder, pers. comm., August 2018). The problem with the current situation is that because the software must be written in a way that makes it so specific to the needs of a jurisdiction's API, it is very difficult for a fisher to move from one software provider to another and retain their historical data. This leaves many fishers feeling trapped into using a single provider, which might be why so many have been reluctant to move from paper-based reporting.

Chapter 5: What is electronic reporting?

The term ‘electronic reporting’ covers a number of different types of technology that independently or collectively allow commercial fishers to report their regulatory and non-regulatory catch information to key stakeholders including quota managers, scientists and environmental groups. Importantly, like with everything else in life, the pace of technology means that there are different solutions being presented to the fishing industry regularly, as hardware and software developers find different ways to help fishers with their businesses.

Table 3 summarises the key types of technology that fall under the banner of ‘electronic reporting’. As highlighted by the dates, many of the technologies have been around for a long time, while some are literally still under development.

Technological system	**Description**
Automatic Identification System (AIS)	An automatic tracking system that uses transponders on ships and is used by vessel traffic services. When satellites are used to detect AIS signatures, the term Satellite-AIS is used (Australian Maritime Safety Authority, 2019).
Vessel monitoring system (VMS)	Systems that are used in commercial fishing to allow environmental and fisheries regulatory organisations to track and monitor the activities of fishing vessels. Regulators can ‘ping’ vessels at prescribed intervals to check they are fishing in approved areas (FAO, 2018).
Video cameras	Video cameras are used by fishing authorities throughout the developed fishing world to check that fishers are catching the species they are licenced to land. Another ‘analogue’ way of achieving the same objective is to put observers onto boats. Both options are expensive and highly inefficient (Archipelago Marine Research, 2018).
Video cameras with Artificial Intelligence (AI)	A number of companies including SnapIT in New Zealand and research agencies including the CSIRO in Australia are developing video camera software with Artificial Intelligence to automatically identify fish types and endangered species automatically, eliminating the need for humans to view footage recorded by cameras on-board commercial vessels (SnapIT, 2018; Archipelago Marine Research, 2018; AFMA, 2019).

Short Burst Data (SBD)	A data service that enables value-added applications to send and receive short data transactions of less than 2 KB in periodic time intervals efficiently. It is ideal for remote monitoring applications used for asset tracking, remote telemetry, and pipeline monitoring and fishing (Martin, D., pers. comm. August 2018).
Electronic logbooks (e-Logs)	In its most literal sense, an e-Log is an electronic replacement for regulatory data that would have previously been lodged via paper and then entered electronically into a government database by a person. In simple terms, by lodging the report electronically to a government backend (API) the need to re-enter the data and the problems associated with handwriting, etc. are removed. It is important to understand that there are three primary types of electronic reports: 1) Web forms - where the form is essentially the same as the paper-based form, but the form is filled on a PC instead of using a pen and paper. 2) PC based software customised to meet the reporting needs of the fishing industry. 3) App based software customised to meet the needs of the fishing industry. (OLSPS, 2018; Catchlog, 2013).

Table 3: Overview of Electronic Technology (Mark Jones, General Manager - FINNZ)

The pace of technological change since the turn of the century has been relentless. Whilst most of the core technologies currently being used in the fishing industry have been around since the turn of the century, hardware and software developers are leveraging exciting new technologies to find solutions to reporting challenges many believed were insurmountable.

5.1 Adoption of smart phone and tablet technologies in developing countries

At a meeting the author held with Anton Ellenbroek (pers. comm., October 2018) from the FAO Fisheries and Aquaculture Department, he explained how the FAO had been involved in the development of the *mFish* app designed to give fishers data about market prices so they could make more informed decisions about where they sell their catch. Another app, *Abalobi*, is designed to collect fishing data from 30,000 artisanal fishers in South Africa. These apps demonstrate that mobile technology is being adopted in third world fishing economies, ironically, at a greater pace greater than many developed countries, including Australia.

Further evidence of adoption of mobile technologies moving at a fast pace in developing countries, was demonstrated at the FAO CFS 45 Committee on World Food Security, where Neema Ward (October 2018) spoke about the *M-Pesa* mobile app that allows the community to use their smart phone to transfer money and access micro-financing outside of the traditional banking system. She observed that in countries like Kenya that had missed out on things the Western World takes for granted such as sanitation, roads and even electricity, were now enjoying better Wi-Fi connectivity than the developed world. She noted that the smart phone had become the highest value single asset held by most of the community, and that it brought significant change to the lives of those who were able to afford it. In a third world country with limited services, she also observed that it was often easier to get a Wi-Fi signal than it was to find the power to charge the device.

David Davies (October 2018) of Ag Unity also spoke at FAO CFS 45 about his apps, AgUnity and AgriLedger that was using blockchain technologies to empower farming communities in developing counties such as the Solomon Islands, Papua New Guinea, Indonesia and Kenya. The platform reduces food fraud, improves traceability and allows the farmer to inform the buyer when his crop is likely to be available for harvest. This transparency for the grower and the buyer avoids oversupplying markets and gives farmers the intelligence they need to know what to plant next. Income owed to the farmer can be spent on items that significantly improve the quality of life for the farmer and it is all transacted via the app. The app also allows farmers to access low interest loans and insurance to deal with things like crop failures or illness that result in cash flow stress.

Whilst these concepts sit outside the scope of this paper, which is really about data collection, it does demonstrate that even third world countries are relying heavily on mobile app technology in their daily lives in a developing world.

5.2 Hardware / software innovation - tablet computers

Whilst electronic reporting has existed on commercial fishing vessels since the 1980s it has been limited to software that runs on PCs that require 240-volt power and waterproof wheelhouses to protect the hardware.

When Apple released the iPad in April 2010 it spawned a new wave of products from manufacturers that are on track to replace traditional PCs within five years. (Macpherson, 2018) When the iPad was first released some critics accused it of being a bit of a toy or an

overgrown iPhone, however the current generation iPad has more computing power than a $4,000 MacBook Pro computer from two years ago. The newest ideas are running on iOS, not OSX (Apple's tablet and PC operating systems respectively) a point made by Xero Managing Director (UK), Gary Turner (Macpherson, 2018). These tablets have far more power than is required to run data capturing software like Deckhand, for example. The new format of a computer without a traditional screen, box or keyboard also affords several other advantages that surprises many fishers. These include:

- Cost - The iPad on which Deckhand runs can be purchased for under $600 AUD.
- Durable and cordless - With a protective case the iPad can be immersed in 3 metres of water for up to 30 minutes, making it suitable for use on boats as small as two metres or even Land Rovers such as those used in the South Australian land-based Pipi fishery.
- Connectivity - The iPad can submit data directly to an API without the need to be sent via satellite or via a thumb drive as used by many fleets today.
- Bluetooth - The same technology that allows the iPad to connect to a car stereo, cordless headphones or a speaker also allows data to be received in the opposite direction from data-loggers that can record things like water temperature and soak time. The same thinking can be applied to linked data sourced from cameras, callipers or scales with Bluetooth connectivity, which can also be time stamped to correlate with data being recorded in Deckhand.
- Customisation - An example of this being how pictures (as opposed to words) are being used for a trial of the Deckhand product in the United Arab Emirates (UAE) where illiterate fishers are using pictures to record the number of fish they land. A similar trial is also underway in the Northern Territory Mud Crab fishery where indigenous and East Timorese fishers are recording their catch via Deckhand where illiteracy is prevalent.

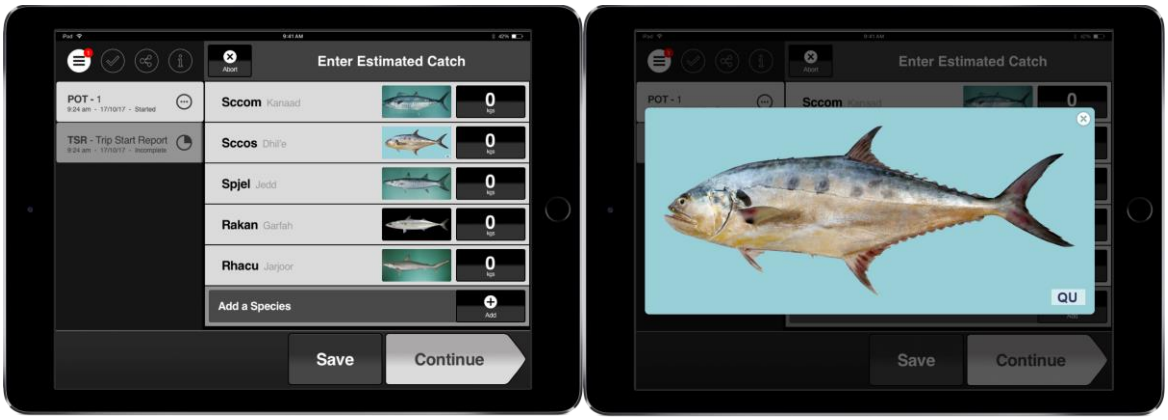

Figure 2: Examples of picture-based reporting via Deckhand for UAE trial, January 2019 (Source: Simon Dick, Director - Real Time Data)

5.3 Hardware / software innovation - Solar VMS (Vessel Monitoring System)

Another innovation currently under development in New Zealand is a new type of VMS that connects to the Deckhand product via Bluetooth. VMS is a core technology that has existed in the fishing industry for decades. It allows the regulator to 'ping' a vessel to see where it is at any given time, or it can be used to allow the fisher to 'ping' its position back to the regulator as part of its regulatory reporting. The Solar VMS product being developed by Snap Information Technologies Ltd (SnapIT) in Nelson, New Zealand, as its name suggests, uses solar energy to power the unit. This significantly reduces the cost of the installation and makes it possible to install the device on boats without mains power. In situations where the vessel is small and doesn't have the 24/48-volt power to run one of the existing VMS solutions, this product could be really important. A proof of concept for the technology is currently being run in the UAE, but it could ultimately be used in remote fishing communities such as the Torres Straight Rock Lobster fishery where some fishers operate their fishing activity from dug-out canoes.

With the pace of technological change, there are large number of packet satellites currently being launched by companies such as Myriota in Adelaide, South Australia. This will mean that it is likely the entire globe will be covered by satellite connectivity within the next five or so years (Simon Dick. pers. comm., April 2018). Practically, this will make it possible to connect to the internet on the top of Mount Everest, Antarctica or the most remote parts of the world's oceans. For commercial fishers, this will allow them to keep in constant contact with their companies, families and regulators, in real time with the next generation of smartphones and tablets.

Chapter 6 - What are the benefits of collecting data electronically?

Somewhat ironically, given the heavy reliance they have on technology to find their fish, the commercial fishing sector has been one of the last to adopt technology to capture fine scale data about their fishing activity.

6.1 The SEPFA Rock Lobster fleet - A case study for context

For context, when the South East Professional Fishermen's Association (SEPFA) fleet started using Deckhand, the fleet was recording their own catch data on an individual fisher basis. Many were keeping the records in their heads (as their fathers had done), some wrote the data in notebooks that they hid under their beds or locked in safes and others transferred their Global Positioning System (GPS) marks onto desktop computers. After a two-year trial where about 25% of the fleet helped to develop the workflows used in Deckhand, the entire SEPFA fleet of 161 boats started collecting their own data using the common reporting technology at the start of the 2014 season. Since that time over 15 million individual pot lifts have been recorded to a common standard, safely stored in the cloud, ready to be accessed by an individual or by the association, if approved by the fisher. To date, there hasn't been a need for the fleet to access their data at a fleet level however according the Executive Officer, Justin Phillips, the association is pleased to be building a bank of data they can all access in the future. Since then, the other South Australian Rock Lobster fleet, from the Northern Zone, has also started collecting their own data using the same product to assist them with scientific work they are doing with PIRSA / SARDI about future management of the fishery.

6.2 Is the commercial fishing industry at risk if it doesn't start collecting its own data?

It is always easy to be clever in hindsight. However, the feeling the author obtained from talking to several fishers, who felt disenchanted by the South Australian Marine Park allocation, was that by allowing the scientists to be the only ones who held industry wide data was a big mistake.

Many fishers can see the benefits of collecting data as a fleet but have been reluctant to change the status quo of engaging the government lead research route because '*that's the way it's always been done'* (Greg Kessegian, pers. comm., March 2018).

6.3 What are the sorts of things commercial fishers could do with the data if they started collecting it electronically?

Despite the fear surrounding data security, virtually all fishers the author met with during the scholarship period could see the advantages of capturing the data, not just for themselves, but for the fleet as a whole. '*We're a funny lot us fishermen. We like to work as individuals, but regret not working together when the government tries to bring in something we don't like'* (Kevin Hoad, pers. comm., May 2018). This point was reinforced by a number of fishers who had seen change to their industry forced upon them by government agencies that were simply able to outmuscle them with science they didn't have the data to refute.

That said, there is no doubt that commercial fishers can see they need to start getting more organised and better 'armed' if they are going to keep access to the wild caught resource they fish. Climate change is a topic that was frequently discussed, with comments like 'we have to fish very differently to the way we used to, to catch fish'.

Dr. Bob Bayer from the University Maine (pers. comm., November 2018) has been studying Lobster in the Maine area for most of his working life. He explained how climate change was forcing fishers to go further out to sea in order to find their catch which was migrating to colder, deeper waters, including swimming further up the coast to Canadian waters that could not be fished with their US licenses.

In the same region, fishers spoke of pressure being put on them by environmental groups to stop the number of whale entanglements with lobster fishing gear. Some cautiously spoke about the risk of the fishery being completely re-managed or even closed if the issues relating to whales were not addressed. All saw the benefit in becoming more transparent about the fishing practices, which they felt were far more sustainable than the negative press being pushed by those wanting to see changes in their fishing practices.

Wayne Dredge (pers. comm., December 2018), a Board member of Southern Rock Lobster Limited (SRL), that represents Lobster fishers in South Australia, Victoria and Tasmania, is working with the author to look at how SRL could use the Deckhand platform to meet their stated objective of lifting the retail price of their lobsters in China to $500/kg.

6.4 Provenance

Another universal issue wild caught fishers deal with is wanting to maximise the return they get for their fish. In a world where aquaculture is supplying more of the world's fish - 170 million tons in 2016, compared to 91 million tons of wild caught in the same year (FAO, 2018), fishers are finding it increasingly important to differentiate themselves from farmed fish, which are typically sold under a different business model of high volume and lower margins. The cost, increasingly conservative fisheries management around quotas, and the unpredictability of catching wild caught fish means that these fishers need to find a way of justifying the higher costs they need to achieve in order to remain viable. Fortunately, consumers are also becoming more demanding in terms of their need to buy fish that is both sustainable and traceable. Consumers, particularly in Asian countries where food counterfeiting is common, will pay significant premiums for wild caught fish with a demonstrable story (Oceana, 2019).

Technologies such as Deckhand will allow fishers to tell that story. The ability to geo-locate where a fish was caught, the name and photo of the skipper, a photo of his boat and the spot (or region to not give away the actual fishing spot) the fish were caught are all the ingredients needed to provide the provenance demanded by a discerning purchaser. Emerging technologies such as Blockchain will rely on producers to start this traceability chain.

Ian Kynnersley (pers. comm., October 2018) from social enterprise, Provenance, highlighted the importance of a story when marketing food. Provence is a UK business set up to address this consumer demand. On the company website the landing page proudly states the following: '*Every product has a story. We help brands and retailers build customer trust through transparency. Provenance empowers shoppers to choose your product*'. The author believes that companies such as this are likely to become prevalent as producers scramble to find ways to differentiate their commodity from their competitors.

6.5 Food safety - traceability

The demands being made of food producers to sell their products into increasingly discerning markets are growing every day. Where the need to demonstrate provenance as outlined above is largely marketing driven, the other requirement for primary producers is to demonstrate traceability for food safety. Products such as Deckhand can be linked into

Quality Programs such as Safe Quality Food (SQF) to link short shelf life products into batches for full traceability.

6.6 Work Health and Safety

As with food traceability, commercial fishers are becoming increasingly exposed to tightening laws linked to worker safety. The author noted that compared to the countries visited as part of the scholarship, Australia has extremely stringent Work Health and Safety (WH&S) laws. One of the advantages associated with putting an iPad or tablet onto a commercial fishing vessel is that the WH&S reporting requirements such as Australian Maritime Safety Authority (AMSA) reporting can be incorporated into a fishers' workflow. Safety documents that were previously filled in by hand, such as a 'Take 5' found on a worksite, can be built into a workflow that forms part of a fishers normal fishing day. Not only can the software be built to prompt the user to answer all the questions before allowing the fisher to proceed to the next part of the workflow, being electronic it also automatically saves the record for auditing purposes. Further functionality can be built in to remind the fisher of scheduled maintenance, product expiry dates on things like flares and even scheduled training activity where the outcomes are recorded and lodged with the relevant authorities.

6.7 Cost savings

Technologies such as Deckhand can also make significant contributions to reducing the operating costs of a fishing business. As outlined earlier in the paper, a common practice on many fishing vessels throughout the developed world is to film the fishing activity on a commercial boat. Because the cost of transferring video data via satellite is expensive and slow, the video data is usually downloaded onto a data-stick and sent to the relevant authority for viewing. This is a very inefficient process where 'watchers' sit in front of screens counting fish as they come over the side. There are significant costs associated with paying people to view footage of extended fishing activities.

One of the insights that came out of this scholarship was linking video data with that being entered into the tablet. David Ellis (pers. comm., February 2019), Executive Officer, South East Tuna Fleet, agrees that costs to fishers could potentially be reduced if video footage could be 'validated' by linking it to data inputted by the fisher. In practical terms this would mean that the regulator would choose a period of time to audit the video and data collected on the e-Log (e.g. For the period 3.15pm to 3.45pm on Monday 7, January 2019). This 'event

log' approach to video plus e-Log data is already working successfully in the Canadian Halibut Fishery (Tiare Boyes and Dave Boyes, pers. comm., November 2018; Archipelago Marine Research, November 2018). At a cost saving level, if the data recorded on the e-Log matched that recorded on the video feed, the regulator could feel comfortable that the rest of the data being collected is being recorded accurately. Typically, a fisheries regulator might have set monitoring requirements for certain categories of fishers, based on past performance. Fishers with a good track record of matching their video data with their recorded e-Log data are afforded a higher 'trust' status and enjoy a corresponding reduction in their licence fees, as the regulator would be spending less time auditing their data. The regulator would then be able to focus their efforts on those who were viewed as being less trustworthy in their recording. This promotes compliance as it rewards those who do the right thing through lower monitoring costs.

6.8 Better Informed Stock Assessments

Another grievance of fishers was the belief that the research undertaken for their fishery was invariably conducted by government agencies, paid for through the cost recovery process. Some fishers questioned the independence of the research conducted by an agency that had links to other government departments where their objective might be reduce fishing effort for political capital. The allocation of marine parks in South Australia being an obvious example where three government agencies, SARDI (science), DEWNR (environment) and PIRSA (fisheries management) all weighed into the debate about where and how many marine parks should be put in place. This quote from a fisher who wished to remain anonymous articulates this well. '*They used our licence fees to pay for research that we didn't get any say in, to ultimately screw us over in the allocation of the marine parks. We only had ourselves to blame because we trusted the scientists to do the right thing by us. If we had collected our own data, we would have been in a stronger position to debate the merits of their findings'*.

By collecting their own fine scale data, fishers would be in a stronger position to debate science with which they disagree. Fisheries that had collected fine scale data throughout the fleet would be better placed to commission an independent stock assessment if they disagreed with the advice being handed down by the government appointed agency.

Further, there are a number of examples of co-managed fisheries throughout the world, with some of the best examples in Australia where industry and government work in

partnership to manage the fishery. It goes without saying that data plays a critical role in the decision making for these fisheries. The South Australian Spencer Gulf and West Coast Prawn Fleet, which is widely regarded as one of the best run co-managed fisheries in the world is currently embarking on a project to collect more fine-scale data through the Deckhand platform.

6.9 Higher economic returns through smarter fishing

In two FRDC funded projects (2017-151 and 2017-152) the Deckhand platform is currently being used to look at ways data collected at a fisher level can be leveraged with scientific, economic and market data to maximise profitability in the South Australian Pipi and West Coast and Spencer Gulf Prawn Fisheries. Working with Ecosearch, a South Australian company who specialise in fisheries economics, the objective of the project is to see if commercial fishers in these fleets can improve their gross margins by fishing smarter and using data they collect themselves and data pulled in by external APIs. Examples of this might include:

- Leaving fish in the water / sand as part of a planned spatial closure to increase their value during faster growing months.
- Calculating the cost / benefit of steaming to fishing grounds further out to sea (therefore burning more fuel but achieving higher prices for the deeper fish).
- And matching market demand to daily catch targets.

The algorithms written for this project could be the forerunner for significantly more efficient fishing practices using Artificial Intelligence (AI) where a skipper could look at a Heads Up Display (HUD) in his wheelhouse, look out to sea and see a big dollar sign to aim for where (informed by an algorithm that references multiple data points) the skipper could start steaming toward. Or, where autonomous boats that pilot themselves to the spots where the highest value fish are, for the lowest possible fuel costs and robots would pull the pots and re-bait the gear. This could result in significantly lower running costs and reduce the number of at sea deaths caused by fishers putting their lives at risk to catch their load.

The author saw many examples of autonomous land-based farming during the scholarship and met with Jonathan Gill (March 2018), a Mechatronics Researcher from the Harper Adams University. His ‘Hands Free Hectare’ project is growing a crop without a single

human hand touching the soil. Projects such as this prove that the concepts outlined above for autonomous fishing boats above may not be as far-fetched as people might think.

6.10 On-line / real time trading of quota (commercial and recreational)

Using a finance analogy in a fishing perspective, where banking apps allow the user to transfer money from one account to another, the technology barrier to transfer quota from one fisher to another is pretty low. It is therefore reasonable to expect that in the short term, apps such as Deckhand will allow fishers to transfer quota from one licence to another or one fisher to another in real time.

If industry and the regulators decide to pursue fishing models such as the Canadian Halibut fishery where commercial fishers can lease their quota to recreational fishers, it would be equally feasible to transact these quota movements on a tablet or smartphone.

6.11 Demonstration of sustainability credentials

Non-Government Organisations (NGOs) such as the World Wide Fund for Nature (WWF) are becoming increasingly vocal about the impact of fishing on the environment. In addition to this, the Marine Stewardship Council (MSC) is using their label to help fishers demonstrate their sustainability credentials. Both organisations place significant value on the validation of data collected by fishers, particularly around the area of Threatened, Endangered and Protected Species (TEPS), such as whale interactions. In a trial managed by Ecotrust Canada, the Deckhand platform is being used by Snow Crab fishers to record where gear was set and hauled using Radio Frequency Identification (RFID) tags. It also provided the fisher with the functionality to record a whale sighting which could be pushed to the rest of the fleet.

At a commercial level the author also attended a presentation run by the ANZ Bank in Singapore as part of the GFP. They confirmed that the ANZ and other banks were lending money at lower rates where farmers could demonstrate their sustainability credentials. Technologies such as Deckhand could provide the evidentiary data required to demonstrate sustainable farming (or fishing) practices.

Chapter 7: A fish is a fish (recreational sector)

In Australia, more than five million people 'drop a line in the water' every year (Mobsby, D. and Koduah, A., 2017). For all its popularity, fishing, be that commercial or recreational, is quite unique in a developed world where the idea of going out to kill your own meal is something that we stopped doing as a society, centuries ago. With the possible exception of duck hunting, stepping outside your door to go and kill yourself something for the fridge will likely see you end up in jail. That is of course unless you are a fisher. Probably because you can't see what you're actually targeting, or perhaps because it comes out of the ocean, people generally have a very different view about killing a fish. It's not just something people do to feed themselves, but something people do to relax.

The ironic thing with this, however, is that unlike the commercial fishing industry where virtually every fish that comes over the gunnel is counted, the recreational sector formally reports a very small percentage of their catch. The recreational catch is commonly estimated using a combination of phone and boat ramp surveys. Established ways of constraining recreational catch are bag and boat limits and temporal and spatial closures. To the commercial sector this causes significant anguish. By way of example, in the Management Options for the King George Whiting (PIRSA Fisheries, January 2016), it was estimated that the split in this fishery was 48.5% recreational, 50.5% commercial and Aboriginal / Traditional owners. Figure 4 tries to demonstrate the reality of the situation, where a fish is a fish – they don't distinguish between a commercial and recreational hook. If regulators and scientists are to make truly informed decisions about the ongoing management of fishing resources, they are going to need to count every fish, not just those caught by a commercial sector that is contracting in size.

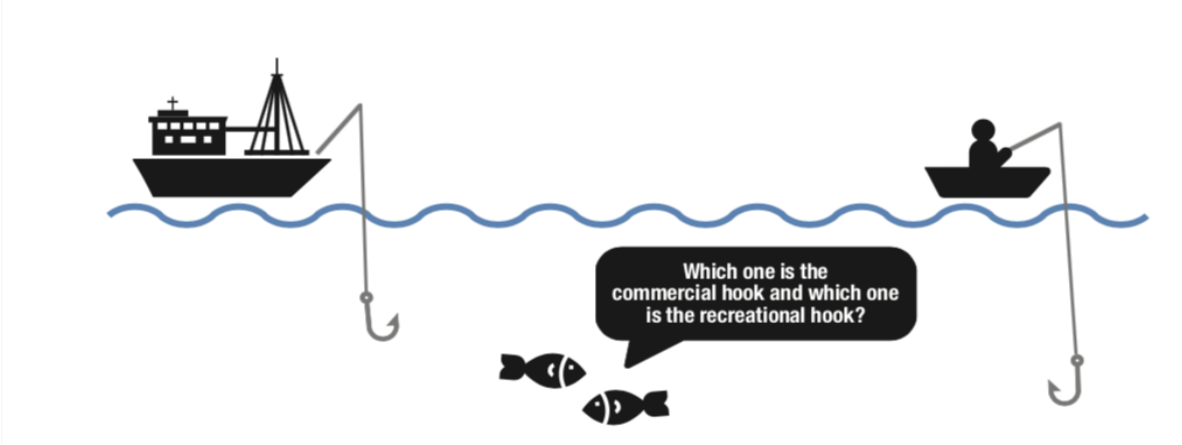

Figure 3: Diagram Commercial vs Recreational Fishing (Source: Simon Dick, Director - Real Time Data)

The author visited the offices of NOAA in Washington DC (November 2018) and met with Richard Cody and Laura Diederick who have been involved in recreational data projects using an app called Tails and Scales. They referenced a program being run in Mississippi where apps had been used to collect data from recreational fishers, where the captured data was 're-captured' by dockside validation to provide greater scientific integrity to the data.

The author also visited Tiare and Dave Boyes (November 2018) on Victoria Island, British Columbia, Canada. They operate in what appeared to be a very progressively managed fishery that used the video cameras described earlier in this report.

An intriguing part of the management of their fishery was the ability for commercial fishers to lease their commercial quota to recreational fishers. This was particularly interesting on two fronts.

- Recreational fishers are being increasingly constrained by reduced bag limits to protect the resource they share with the commercial sector. Those who have invested heavily can find this frustrating when their fishing day ends as soon as they have reached their bag limit.
- Commercial fishers are sometimes forced to leave fish in the water when the cost of production (crew, bait, fuel, repairs and maintenance, etc.) is higher than the price they are being paid by the market. This often occurs when the fish are in high abundance and larger than typical volumes depress market prices.

This win / win scenario allows recreational fishers to lease quota from the commercial sector for an amount (say $5/kg) that is higher than the margin commercial fishers can achieve in an oversupplied market.

At a philosophical level this addresses the perceived inequity the commercial sector believes exists, in that every fish is paid and accounted for in a transparent market. There are a number of other social and scientific benefits attached to this transparent form of fisheries management.

This scheme outlined above is currently managed via a web portal which means that most of the transactions occur before the recreational fisher has gone to sea. There would appear to be an opportunity for phone or tablet-based apps to be developed that would allow for commercial to recreational (or even recreational back to commercial) transactions in real time. Using a banking analogy there would be little difference to trading quota from a commercial operator to a recreational one, in the same way people transfer funds from one bank account to another.

Conclusion

The previous chapters outline serious trust issues surrounding data that exist between industry and government. This is a universal problem repeated in every jurisdiction the author visited as part of the scholarship. The GFP uncovered similar problems with trust in other agricultural sectors including data collected by things as diverse as robotic milking machines in the dairy industry and farmers who shared data with companies such as Syngenta and Bayer. The blurred line about who owns the data and clarity about what it could be used for, left all farmers interviewed during the scholarship, at best highly suspicious about anything to do with data collected on the farm.

An interesting insight from those interviewed was a belief that there wasn't anything technically challenging about storing data. There was universal agreement that if it is safe to store financial data online, then at a technical level there was no reason why data couldn't be stored in an environment that offered the same security protocols as a bank.

Which raises the obvious question, if there isn't a technical question about the security of data, what is stopping farmers or fishers generally from feeling comfortable about electronically recording their commercially sensitive data?

This leads to one of the most important insights from this scholarship. A key learning that transcends every sector interviewed was a distrust of the government or regulator. A body which could make decisions to change the current laws of the day, that would allow the government the power to retrospectively gain access to data that had been recorded for the farmers' own 'non-regulatory' purposes. Table 4 demonstrates the type of data a fisher using a product like Deckhand can collect in a typical days fishing.

Report type	**Purpose**	**Regulatory**	**Non regulatory**
Prior report	Advises compliance officers and quota managers that a fisher is going fishing.	*Yes*	
Pre-start checklist for the vessel	Ensures that vessel is in a condition suitable for it to go to sea and that the crew is adequately trained.	Depends on jurisdiction	There could be aspects of a pre-start checklist that may be important to the skipper but not regulatory. For example, fuel usage and a repairs and maintenance log.

Maintenance log	A digital reminder that allows the fisher to ensure the vessel is meeting its survey requirements.	No	Important to ensure that consumables such as flares, life rafts etc are kept in date.
Fine scale pot by pot lift	This is where a fisher geo-locates where a pot was pulled and what was in the pot.	Depends on jurisdiction	Important for fishers to know where and when they caught their fish.
Wildlife reporting	This would allow the fisher to record sightings or interactions with a threatened, endangered or protected species (eg. Bird, whale, etc.)	Depends on jurisdiction	Fishers are often in the sights of environmental groups. Voluntarily collecting data when not already required would put industry on the front foot with these groups.
Online quota transfer	Would allow a fisher to lease in additional quota while on the water.	Yes	Important in fisheries where 'choke' species can stop a fisher from catching the fish he has quota for. Or, simply to lease in additional quota for a species they have caught a lot of.
End report	Advises compliance officers, quota managers and scientists what was caught on that trip.	Yes	NOTE: This only records what fish was on-board, not where it was caught.
Market prices	Real time market advice pushed to the boat.	No	Allows the fisher to know where the best prices are being paid for the catch he has just landed.
Advertising	Fishers could be pushed relevant advertising message offers from companies with product to sell to the sector.	No	This could be a way that fleets could save money and recover money for the software by selling their platform to advertisers.

Table 4: Example of Deckhand workflow. Note that from a regulatory perspective, only the prior and end report are regulatory requirements. The rest of the data is collected or accessed by the fisher to make smarter commercial decisions in the business (Source: Simon Dick, Director - Real Time Data)

The thing that worries the fishing industry is that if they record fine-scale data for their own business intelligence, or (for example) to assist in collecting data for an alternate view on stock assessment, it may be used for something else. The thing that stops many of them doing this at present is that in law, the minister responsible for the fishery could, to use their words, 'go rogue on them' and bring in a law that retrospectively gives the government the right to access the fine scale data the fishers had collected in good faith. There is precedent for this. For example, the Australian Tax Office or police can ask for 'non-regulatory' data to assist them in building a case for prosecution.

The following quote from Justin Phillips, Executive Officer for SEPFA (September 2018) sums up the sentiment succinctly. '*In the context of data security, from an industry perspective, we are comfortable and have a good level of confidence in the current political environment. However, we are cautious about future changes in government and when the bureaucracy, which may be lead by legislative change, or even differences in the interpretation of legislative intent, may impact on the security of our information or the purpose for which it was used*.

It is fear of the unknown that has many fishers deciding it is simply safer to continue to keep their commercially sensitive data in their heads or written down in books, locked away in safes that can't be accessed by that 'rogue' minister on behalf of a government wanting to implement change.

Figure 5 demonstrates the way fishers view their data being treated by the regulator or science agency. That is, the data they collect on their boat goes directly to the government but has no other value. Figure 6, and this report, attempts to demonstrate that the regulatory requirements of on boat reporting represents only a small percentage of the value commercial fishers can derive from storing all their data (regulatory and non-regulatory) in a safe and secure data repository.

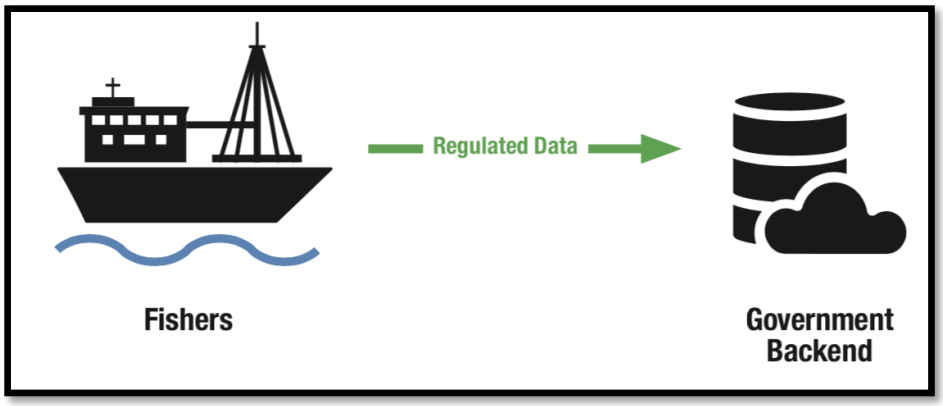

Figure 4: Current Government Data Stream (Source: Simon Dick, Director - Real Time Data)

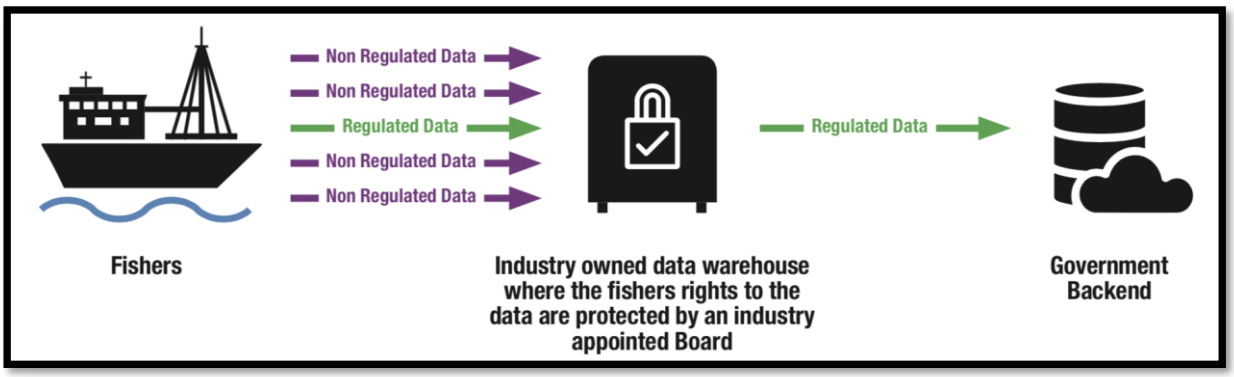

Figure 5: Recommended Government Data stream (Source: Simon Dick, Director - Real Time Data)

For the reasons outlined in this report, the author believes that fishers should be encouraged to record lots of data. The challenge is to find a pathway that will give them certainty that their data is safe and not accessible by a government who can change the rules to access their data retrospectively.

Recommendations

- Commercial fishers need to decide if the perceived risk of collecting (and storing) electronic data is outweighed by the benefits associated with collecting it.
- State and Commonwealth fisheries regulators who have or are in the process of building back-ends to accept regulatory fishing data will result in 'silos' of information. This will make it difficult to compare data from one jurisdiction to another and discourage investment from software developers who need to connect to their APIs. The author recommends that regulators work in a collaborative way to make their data compatible across all states and jurisdictions.
- Industry should consider building its own data warehouse to store all of its data before forwarding (only) the regulatory data to government stakeholders.
- For this strategy to work, industry would need comfort that its interests were being looked after. Thought should be given to forming a working group to determine what a Data Warehouse Board might need to do and the type of people who should sit on it.
- Building an industry owned data warehouse would also assist in dealing with issues relating to data harmonisation. Solving this issue would encourage third party software and hardware developers to invest in an industry approved standard. This would also benefit fishers because more software developers would equal more choice and fishers could move from one software provider to another with ease.
- As part of this process, industry should consider strategies that could provide more comfort around storing historical fishing data. For example, seeking legal advice to explore the legal implications of storing the data in countries that claim to have stronger laws relating the accessing data retrospectively, such as Switzerland.

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Plain English Compendium Summary

Project Title:	Fishers Should be Encouraged to Collect Data. Lots of It!
Nuffield Australia Project No.:	1823
Scholar:	Tom Robinson
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Objectives	• To clarify the role of the regulator in fishing and their need for accurate data. • To understand the different ways commercial and recreational fishers record their catch and what the data is used for. • To explore what regulators are doing to get themselves ready for electronic reporting and how they intend to use the data they receive. • To define what options are available to industry to collect data and what is on the horizon. • To explore what other benefits can be realised through data by having a device such as a tablet onboard commercial (and recreational) fishing vessels? • To determine how recreational fishing data can be better managed for the future management of fisheries.
Background	The fishing sector could arm itself with significantly more data by dropping paper and moving to electronic reporting. However, for reasons that have little to do with the technology itself, they are very reluctant to do so.
Research	The study conducted was completed by interviewing key industry stakeholders in Australia, New Zealand, Europe and North America.
Outcomes	The study uncovered the reasons for delaying the move to electronic reporting were not technical, but trust and legal issues.
Implications	This study revealed there are significant benefits associated with moving to electronic reporting that are well understood and well supported by industry. However, until fishers have confidence that the data they collect cannot be used against them, they will remain extremely cautious about recording anything more than their regulatory data.
Publications	An overview of this project has been published in the FRDC Fish Magazine dated June 2019. Presentation at Nuffield National Conference, Brisbane, September 2019