

Real-Time Fishery Management™

and



FACTS™

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Real-Time Fishery Management™ and FACTS™

Definition of Real-Time Fishery Management™: *“Providing the ability for a fishery manager, fisher, enforcement officer, or other authorized stakeholder to obtain trip-level hail, catch, logbook, quota, or other applicable data during or immediately following the conclusion of a fishing trip”.*

The definition of Real-Time Fishery Management™ is provided from the perspective of Electric Edge Systems Group Inc., which offers an integrated software solution known as Fishing Activity & Catch Tracking System (“FACTS™”). FACTS™ provides applications and infrastructure that enable Real-Time Fishery Management™.

FACTS™ is comprised of modules that can be used together as an integrated system or in any combination to meet the varying needs of fisheries worldwide. The idea is to produce an electronic view of the portion(s) of fishing trips that are typically monitored (i.e. activity hails, fishing logs, and the landing of catch), as well as a fourth module for the tracking and management of quota/ACE.

FACTS™ data collection modules are comprised of two main components - software for data collection in the field, and a central online portal for the reporting of received data, management of key settings, and data exporting. The central portal also allows for integration with external systems as it can transform and/or send data to other systems as soon as it is received. As an added bonus, the modules can be easily tailored to suit the specific requirements of most fisheries.

Major Parties and Data Sets in Real-Time Fishery Management™

There are up to seven parties (stakeholder groups) and five sets of data that are generally involved in well-managed fisheries:

Stakeholders:

- Fishery Managers
- Enforcement Officers
- Fishers
- At-Sea Monitors
- Dockside Monitors
- Seafood Dealers
- Scientists

Sets of Data:

- Hails
- Logbooks
- Landed Catch
- Quota
- Quota Calculation Data (e.g. discard rates, conversion factors and catch mortality rates)

A typical relationship between the stakeholders and data sets in Real-Time Fishery Management™ is illustrated below. The meaning of the diagram will become clearer later in this document as further details are provided regarding the role of the stakeholders and data sets. Please note that a line running from a data set to a stakeholder (arrow pointing to stakeholder) indicates that the stakeholder is a consumer of the data. Conversely, a line running from a stakeholder to a data set (arrow points to data set) indicates that the stakeholder is a producer of the data.

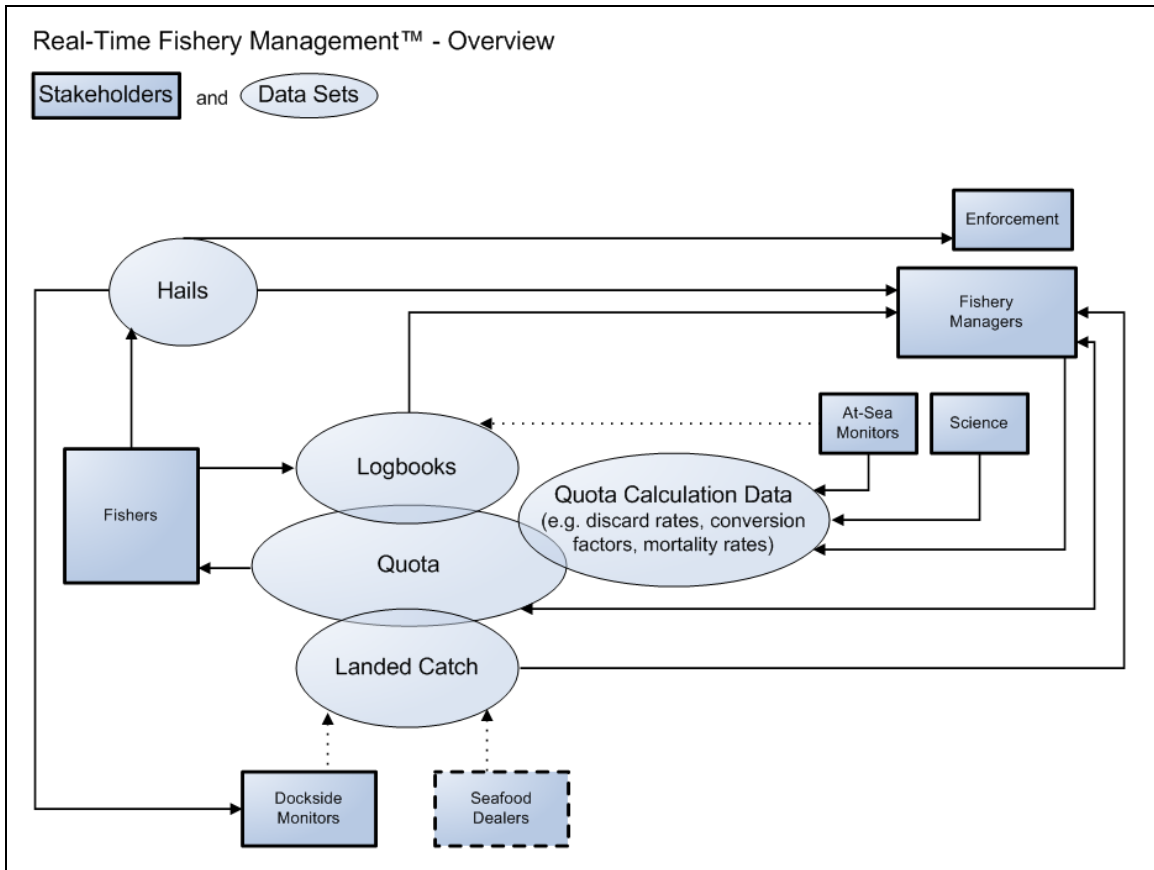


Figure 1 – Parties and Data Sets for Individual Quota/Catch Shares Fishery Management.
NOTE: The diagram shows an arrow from the quota data set to fishers, indicating an individual quota fishery in which quota is assigned to each individual fisher/license holder. The arrow may not exist for fisheries in which quota (AKA “annual catch entitlement”) is applied to the entire fishery.

FACTS™ Modules in Relation to Data Sets and Stakeholders

Various modules exist or are being developed for FACTS™. Collectively, they address the needs of the various parties and sets of data that were identified in figure 1. The following sections describe the FACTS™ modules, the components of Real-Time Fishery Management™ that they address, and the stakeholders that will typically access the data.



E-Hails Module

Overview and Primary Usage

Hails are a key element of Real-Time Fishery Management™. They are notifications of trips and their associated landings that are usually sent prior to departure and when a vessel is heading back to port after fishing has concluded. The hails module is used either aboard vessels or by a call center for entry of hails that are relayed by vessels (e.g. via cellular or satellite phone). Once hail data is received it can be made available to dockside monitors, enforcement officers, and any other stakeholders that may need to review or act upon it. Specific uses and benefits will be outlined in the sections below.

Hails provide dockside monitors with advance notice of landings, so that monitoring staff can be deployed to the applicable ports.

Additionally, copies of hail data are usually provided to enforcement officers in real-time so that vessels that are under observation can be tracked and observed upon landing. Hails serve another important purpose as a hail is often the first set of data received for a new trip. This allows a new trip record to be created in the central database. As further information is received during the trip (e.g. logbooks, landed catch, and the subsequent hails), the base trip record is updated until a complete electronic view of all monitoring data exists for the trip.

In most fisheries that use hails, fishers are required to send at least two hails per trip. The first hail (often called a “trip start hail” or “hail-out”) is usually required prior to the vessel’s departure on a trip. The second hail (“trip end hail” or “hail-in”). Is required in advance of the vessel returning to the first port at which catch will be offloaded. The amount of advance notice will depend upon the fishery and the amount of time that it may take for a dockside monitoring contractor to dispatch a monitor to the port. In general, fishers will send a trip end hail when fishing has stopped and the vessel is underway to the landing port. A proper hails system will allow the fisher to revise hails that were previously sent so that dockside monitors can be advised when expected landing dates, times, or locations have changed.

Hail messages will include information that identifies the vessel and/or license, as well as the date, time, and place at which catch will be offloaded. These last three elements are estimated in the trip start hail, but are expected to be accurate in the trip end hail. In addition, the end hail will usually include information to identify the seafood dealer(s) that will be purchasing the catch, and an estimate of total catch. The catch estimate is useful

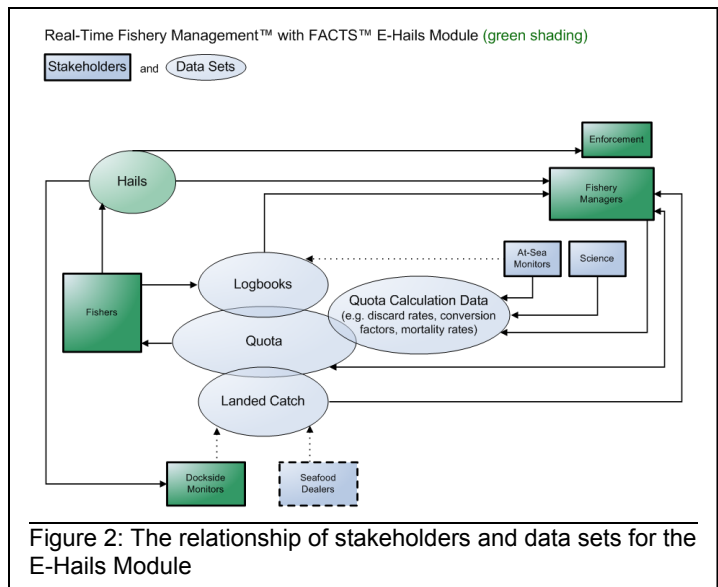


Figure 2: The relationship of stakeholders and data sets for the E-Hails Module

to dockside monitors as it helps them to estimate the amount of time and effort that will be required to count/weigh the catch at the dock.

E-Hails Technical and Usage Details

Hails require vessels to carry communication equipment onboard that allow data communication or that allow a voice call to be made to a call center for hail entry. For fisheries that take place in cellular range, a simple method of data communication is to use an SMS (text messaging) application for hailing. The FACTS™ Electronic Hails module can be adapted to accommodate this option.

Data communication is far preferable to voice because it ensures that the data provided by the fisher is the data that is saved to the central portal and is passed along correctly to dockside monitors and regulatory bodies. When relaying hail information by voice, (especially via a poor quality satellite or radio signal), the call center could enter the hail information incorrectly. With direct data communications, positive confirmation of hail data is provided. With FACTS™, the central portal sends a confirmation e-mail message back to the sending vessel when a hail is received. The confirmation repeats key hail details back to the vessel to assure the fisher that the intended hail data was received correctly.

Vessels that operate under Real-Time Fishery Management™ are likely to have equipment that falls into one of the following categories:

1. No computer onboard. Vessel provides ship-to-shore voice communication via cellular and/or satellite phone or radio.
2. No computer onboard, but the fisher/skipper has a cellular phone with standard SMS text messaging.
3. Vessel has a computer onboard, along with equipment and software such as Skymate® or Boatracs®, which allows short e-mail messages to be sent from the vessel and received by the vessel via satellite.
4. Vessel has a computer onboard and two-way data communications using a cellular modem, satellite modem, and/or satellite phone used as a modem.

Category four is the best option as it allows the onboard hail software to connect directly to the central FACTS™ portal, send the data, and receive instant confirmation (or an error message if incorrect/invalid data was received). This two-way interactive type of communication allows the onboard software to update the status of the hail to indicate whether it was received successfully

Under category three, the hail data is sent as a specially formatted e-mail message that is sent to a specific e-mail address/account. The central FACTS™ portal checks the e-mail account for messages at regular intervals (e.g. once per minute). When a hail message is received, the hail data is extracted from the message and validated. If the hail is valid, the central portal database is updated and a confirmation e-mail message is sent to the vessel. If the hail is not valid, an e-mail is sent to the vessel with an explanation of the error and suggestions on correcting the hail. Under this one-way, non-

interactive scenario, the fisher will watch for the confirmation/error e-mail message from the central portal and then take action if required (e.g. correct a hail and re-submit it). In Electric Edge Systems' experience, the system has worked very well overall.

Category two provides an interesting alternative for fisheries that take place in areas with cellular communications coverage. Under this option, simple hails can be made via text messaging. In this scenario, the fisher sends a text message to the central portal, which responds with a message asking for the fisher's password. When the password is entered correctly, the central portal sends messages that ask questions about the hail (e.g. license number, planned landing port, landing date, landing time, etc.). The fisher responds to each question and the central portal validates the data. If invalid data is entered, a text message explains the problem and the question is repeated. When the questions have been answered, the hail is saved to the central portal which sends a final confirmation text message to the fisher containing a unique hail or trip number.

Category one is the least desirable but is still workable as a real-time source of hails data. The main drawback of this approach is the possibility of errors in hail data that is being relayed to a person by telephone. In some areas, such as British Columbia, satellite phone coverage is of relatively low quality with calls that are frequently dropped. As such, a hail call may take several attempts and can be time-consuming and frustrating for fishers.

Since spring 2010, Electric Edge Systems Group has successfully deployed electronic hails software (also known as "EasyHails™") to fishing vessels in the Northeastern USA and British Columbia that are equipped with onboard computers and category three or four data communications equipment.

Secondary Users of E-Hails

Although dockside monitors are the primary users of hail data, enforcement officers may access and report hail data. If a vessel is under surveillance, enforcement may use hail data to determine a vessel's next landing so that the vessel can be placed under observation when it lands and offloads its catch. Alternately, active trip hail numbers can be provided to enforcement officers who can use that information to determine whether vessels seen on the fishing grounds should be fishing.

Fishery managers or industry groups (e.g. "sectors") find hail data to be very useful. When viewed in real-time, hails indicate current fishing activity (e.g. the vessels that are currently at-sea and when they are due to return). Hail data can be analyzed to produce reports such as trip frequency over time and number of offloads at each port.

Finally, with FACTS™, fishers themselves can logon to the central portal to view their previous hails within any specified range of dates. Fishers can find this to be useful in the event a dispute arises about scheduled offloads.



E-Logs Module

Overview and Primary Usage

The electronic logbooks module is used by fishers to send logbook data either from the vessel or from shore shortly after completion of a fishing trip.

The electronic logbook data is used by the quota management module for calculation of remaining quota and is accessible by fishery managers and scientists for viewing, reporting, and analysis.

In a Real-Time Fishery Management™ system, logbook data is provided by fishers in electronic format, using an onboard computer and logbook software such as the FACTS™ E-Logs Module.

Logbooks indicate the date, time, and location of each fishing event. A fishing event may consist of a single “set” (e.g. placement and hauling of a longline or net), a period of time (e.g. 24 hours), or fishing activity with a unique combination of area and gear type. For each event, the log will record the quantity of each species caught and retained in each area and may include additional information such as catch that was released/discarded and details regarding the type of gear used and its configuration.

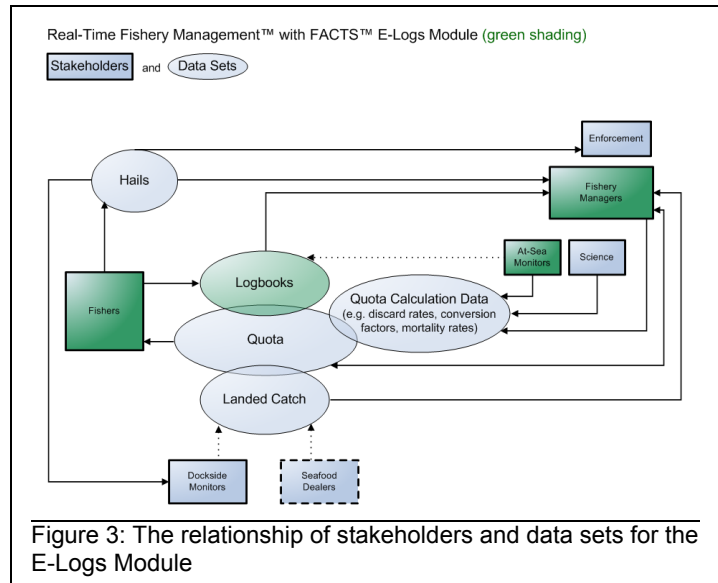
Logbook data plays a crucial role in the calculation of remaining quota when quota is assigned by area and/or species. Although quota calculations determine the quantity of catch based on landed catch records, the logbook data is used to apportion the landed catch to each area that was fished. This is how catch is allocated to each area and how remaining quota is calculated on an area-by-area basis.

E-Logs Technical and Usage Details

When logbook data has been recorded by the fisher, it is sent to the FACTS™ central portal in one of two ways:

1. From the vessel/fisher via a satellite or cellular connection that provides an internet link or the ability to send e-mail messages
2. On shore using a wireless or other connection to the internet

Alternatively, if a fisher does not have a computer onboard, the logbook data could be recorded on paper and then the information can be entered into the FACTS™ portal online after the trip. Obviously, this would be a departure from “real-time” data



processing. On the other hand, under Real-Time Fishery Management™, it is in the fisher's best interest to get the logbook data into the system quickly since a fisher will not be permitted to start a new trip until all data from the previous trip has been received.

Secondary Users of E-Logs

Although fishery managers will be the primary users of the logbook data, scientists will also find this data to be quite useful. Scientists can use the data to determine the amount of fish taken from each area being fished. In addition, logbook data can be compared with historical data to produce trend analysis and check the impact of various control measures over time.

Fishers are able to access logbook data either from an onboard computer or via the FACTS™ central portal. Logbook data allows fishers to track their catch over time for the planning of future fishing activity. In the event of a dispute, logbook data provides verification of the information that was previously submitted to regulatory bodies.

For derby style fisheries (fisheries without individual quota), fishery managers can use the real-time logbook data to make closure decisions where accurate catch landing data does not exist.



Landed Catch Module

Overview and Primary Usage

Landed catch is the key component for precisely determining the quantity of each species that has been removed from the environment and retained. These quantities are apportioned to the areas that were fished (as reported in the logbook) to determine the catch from each quota-applicable fishing area, which is then deducted from the fisher's or fishery's remaining quota. Landed catch data is accessible by fishery managers for viewing, reporting, and analysis.

Typically, landed catch data is provided by a dockside monitoring organization, or by the seafood dealer or processor that has purchased the catch from the fisher.

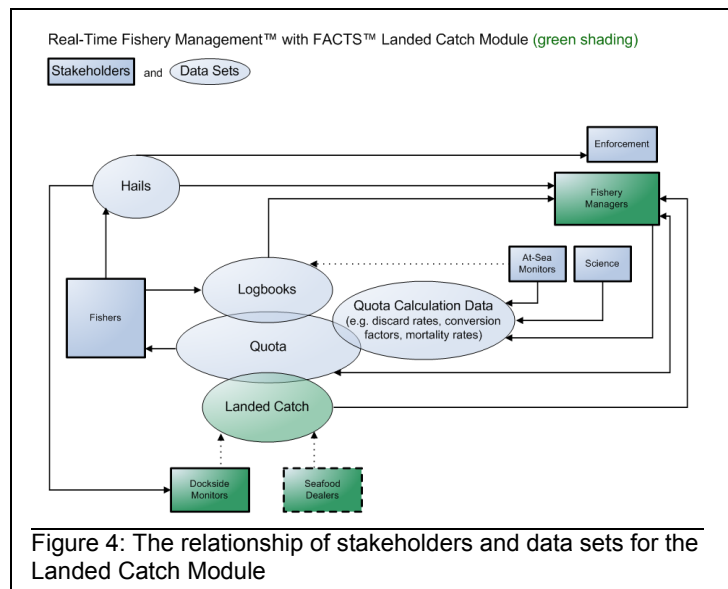
The diagrams in this document show a dashed line between the dockside monitors and landed catch and between seafood dealers and landed catch because either party may supply the data. The seafood dealer shape is outlined with dashes because under Real-Time Fishery Management™, **using seafood dealers/processors as the source of landed catch data is not recommended.**

There are several reasons for implementing full dockside monitoring and using dockside monitors instead of seafood dealers as the “source of truth” for landed catch.

These reasons are provided in detail later in this document in the section named “Fishery Management Practices to Avoid”.

Landed Catch Technical and Usage Details

Currently, the FACTS™ landed catch module is being developed for use by dockside monitors with mobile devices. Under Real-Time Fishery Management™, dockside monitors will record catch as it is offloaded. Upon completion of the offload, the offload data will be sent to the FACTS™ central portal via a wireless connection to the internet using “wi-fi”, or a cellular connection if the mobile device has cellular capabilities. In the event that a device has a connectivity problem, a file could be saved to an external device (e.g. a USB drive) and then uploaded from a connected computer to the FACTS™ portal. The final option would be to enter the landed catch data via web forms on the FACTS™ portal.



Secondary Users of the Landed Catch Module

Although fishery managers will be the primary users of landed catch data, scientists will also find this data to be quite useful. Scientists can use the data to determine the amount of fish taken from each fishing area when the landed catch data is integrated with logbook data. Landed catch data is preferred by scientists over logbook data as it is accurate data verified at the dock as opposed to estimates made at-sea.

As with other modules, fishers are able to access landed catch data via the FACTS™ central portal. This allows fishers to see their catch over time to aid in future fishing activity as well as verify what was submitted to regulatory bodies in the event of a dispute.

Fishery managers can use real-time landed catch data to make closure decisions in derby (non-quota) style fisheries.

Fishery sustainability certification groups (if authorized) can access the FACTS™ central portal for the purpose of obtaining accurate catch statistics for the fishery being assessed.



Quota Management Module

Overview and Primary Usage

The quota management module integrates the information from the other FACTS™ modules to perform quota calculations and report on the status of quota for the fishery. For catch shares fisheries, quota can be calculated and reported at the level of a single license, all licenses held by an individual or group, or the entire fishery. The quota management module also provides the interface for science staff, at-sea monitors, or fishery managers to maintain the core data used in quota calculations.

Quota calculation data is used in all types of fishery management systems and is not specific to Real-Time Fishery Management™. The advantage of real-time

collection of fishing activity data is that remaining quota can be calculated immediately at any given time, making fishery management and planning simpler and more accurate.

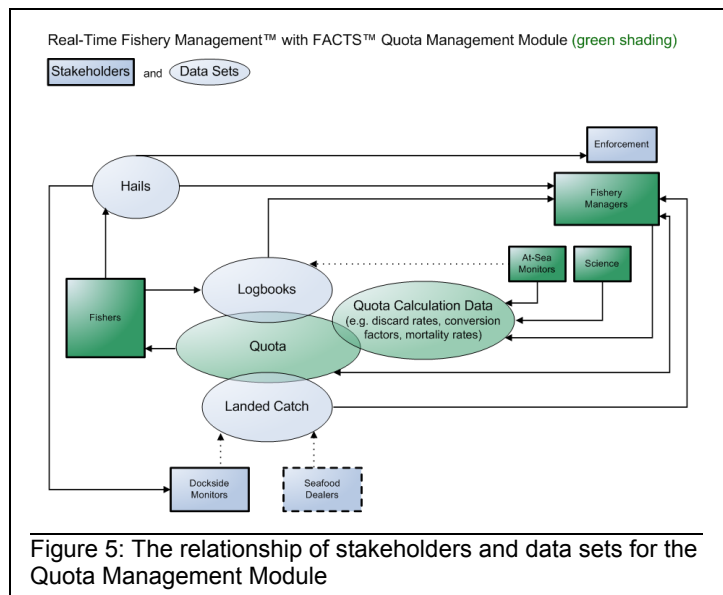


Figure 5: The relationship of stakeholders and data sets for the Quota Management Module

With FACTS™, the quota module is the core system that processes catch data from the landed catch records, combined with the spatial (e.g. fishing area) data from logbooks, to calculate remaining quota for each species/area combination.

Quota Management Module Technical and Usage Details

In addition to using landed catch data combined with logbook information, other sets of data are used in quota calculation, such as the following:

- **Discard Rates:** Some fisheries or some trips may have an independent observer/monitor or electronic monitoring (e.g. video) equipment onboard to record discarded catch. For these trips, discards will be reported directly to the FACTS™ central portal and deducted from quota (a mortality rate may be applied). For trips that are not observed, discards may be estimated automatically for each species, based upon historical discard rates for similar trips. Discard rates are often a percentage of total catch either for the same species or all species combined. Estimated discards are usually applied directly against quota.
- **Conversion Factors:** For accurate reporting of quota, the weight of landed catch should be converted to its live weight equivalent. For example, the weight of a fish that has been gutted will be less than the weight of the fish when whole. In some cases, the landed catch may represent an even smaller portion of the whole organism. Examples include skate wings and monkfish tails. For quota management purposes, a conversion factor must be set-up for each plausible combination of species and product “form” and/or product “state”. These conversion factors are applied to landed weight in order to determine the live weight equivalent of landed catch. The estimated live weight is then applied to quota.
- **Mortality Rates:** In some fisheries, a mortality rate is applied to discarded catch, especially when discarded catch was directly observed and reported (most of the time, a mortality rate is factored in when discards are estimated based upon discard rates). Mortality rates for each species may be based upon the type of gear used and the “soak time” (e.g. how long a net or longline was in the water).

Most sets of quota calculation data are provided by fisheries scientists. In the central FACTS™ portal, scientific staff, a fishery manager, or the FACTS™ system administrator may enter and maintain most of the sets of data. Additional sets of data, such as actual observed discards for monitored trips, may be entered or provided by at-sea monitors or personnel who review data from electronic monitoring equipment. Some base data such as lists of quota-applicable species may be provided and entered by fishery managers.

Since FACTS™ is a real-time system, quota calculations can be performed at any time and are run “on the fly” (as opposed to being part of a scheduled batch process). Quota status reports can be based upon an entire fishing season, the current season to-date, or a range of dates. For fisheries that are based upon catch shares/individual quota, quota status reports can be produced for an individual fishing license or set of licenses.

Secondary Users of the Quota Management Module

Quota information is of particular interest to fishery managers as it allows the quota status of the entire fishery to be accessed at any point during the fishing season (based upon all *completed* trips to that point).

In fisheries that have implemented catch shares, quota information will be tracked closely by fishers/license holders and possibly the industry groups that they are associated with.

In catch shares fisheries, fishers/license holders are continuously reliant upon accurate, up-to-date figures regarding their remaining quota. This allows fishers to plan the usage of their quota such as acquiring additional quota, fishing their quota, or leasing quota to other license holders.

Quota data can also be of value to industry groups that may be responsible for managing quota (e.g. fishing “sectors” in the Northeastern US).

Access to current and historical quota data may be of interest to industry groups and certifying bodies (e.g. the Marine Stewardship Council) for reporting, planning, and certification purposes.

Fishery Management Practices to Avoid

There are certain established management practices in many fisheries that should be avoided as they inhibit the flow of data that is required for Real-Time Fishery Management™. Three examples are provided below.

Seafood Purchasers as Official Source of Catch Data

Many fisheries have a long-established reliance upon seafood dealers/processors as the official source of catch data. In some cases, dockside monitoring has not been implemented or has been partially implemented (e.g. used only to spot-check dealer catch data).

There are several reasons for implementing full dockside monitoring and using dockside monitors instead of seafood dealers as the “source of truth” for landed catch. These reasons include:

- **Timeliness of reporting:** Some seafood processors may not report their catch until well after it has been offloaded from vessels. Additionally, in many fisheries, dealers/processors have several days to file catch reports. Such reporting does not meet the “real-time” requirement of Real-Time Fishery Management™. By contrast, dockside monitors collect catch data upon offload and in most cases, should be able to submit data electronically upon completion of the offload process.
- **Data Quality:** Reporting of catch data to regulators is not the core business of seafood dealers. In all likelihood, most seafood businesses view the reporting requirements as an inconvenience and a bureaucratic exercise that they would prefer not to perform. As such, seafood dealers/processors may not be willing or

able to devote the resources to ensuring accurate data. By contrast, data collection and reporting are the core competencies of dockside monitoring organizations.

- **Conflict of Interest:** Fishers and seafood dealers are both in a position to benefit from collusion to understate catch. As such, official catch counts should be performed by an independent third-party with no direct benefit for false catch reporting.
- **Enforcement:** A given fishery may involve hundreds of seafood dealers/processors, but most fisheries will involve only a handful of dockside monitoring companies. For example, in the Northeastern US groundfish fishery, there are no more than four dockside monitoring companies. For British Columbia groundfish, a single contractor is responsible for all dockside monitoring. Both fisheries involve between several dozen and hundreds of seafood buyers. Entities that provide official catch numbers must be subject to regulatory oversight, investigation, and audit. The cost effectiveness of overseeing a handful of dockside monitoring contractors as opposed to hundreds of seafood businesses is self-evident.
- **Use of Technology:** Catch data can be submitted electronically in real-time using a mobile device such as a tablet computer, with a suitable application such as the landed catch module being developed for FACTS™. Since dockside monitors are in the data collection business, they are likely to be more familiar with computers and applications software than seafood dealers would be. When deploying technology, it is preferable to deal with a small number of dockside monitoring firms that can organize their own distribution of devices and training of staff. This option is much simpler and requires far less effort than having to deal with large numbers of seafood dealers of various sizes and technological capabilities.

Reliance on Paper Forms

Paper forms may have a place in trip data collection. In some cases, trip data may be recorded on forms, provided that it is then transcribed into the central fishery management system by the time at which the trip is completed. Paper forms may also serve as a backup source of data and may be required if regulations require the recording of a party's signature.

In some fisheries, data is collected on paper forms, which are then sent to a different location for data-entry during business hours. In at least one fishery, fishing trips are fully monitored and include fisher logbook, at-sea monitoring, and dockside monitoring data. The fishery however, does not meet Real-Time Fishery Management™ standards because all of the data mentioned is recorded on paper forms, which are then faxed to an office for manual entry into a central trip/quota management system. New trips may not be permitted to commence until all data has been received and entered for the preceding trip. This fishery aims for a "turn-around time" of 2-5 days between trips. This falls far short of the requirements for Real-Time Fishery Management™.

Quota Calculation Data Applied Retroactively

In at least one catch shares/individual quota fishery, a set of quota calculation data (in this case, discard rates) is updated on a weekly basis. This in itself is not an issue for Real-Time Fishery Management™, but in this case, when new discard rates are released, they are intended to be applied retroactively to all previous trips in the current fishing season. The result is that the remaining quota that was reported to a license holder is subject to change, even when no trips have occurred since the quota was last reported.

As an example of the effect of retroactive quota calculation data, a license holder/fisher who makes numerous day trips could have taken 100 trips by the mid-point of a season. The fisher could create a quota status report which calculates the quota used on the 100 previous trips to produce a report of current remaining quota. The next day, the fishery management organization could release a new set of discard rates. In order to determine remaining quota on that day, the fisher must obtain a new quota status report which means that quota used on the previous 100 trips must be re-calculated again (based upon the new discard rate data).

Retroactive changes to quota calculation data or methods is not compliant with Real-Time Fishery Management™ because quota figures that are based upon information that was provided in real-time are of little value as those figures will become stale at some point in the future. If adjustments to quota calculation data are required, they may certainly be implemented under Real-Time Fishery Management™, but should only be applied to subsequent (not previous) fishing activities. The new quota calculation data should be set to take into account the corrections needed to compensate for quota calculation data used on previous fishing activities.