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journal or publication title	Proceedings of the International Conference on Fisheries Engineering 2019
year	2019-09-22
権利	Posted with approval of the Japanese Society of Fisheries Engineering
URL	<a href="http://id.nii.ac.jp/1342/00001907/">http://id.nii.ac.jp/1342/00001907/</a>



# Quantitative Analysis of Computerization for Operations of the Fish Market

## - Case Analysis of Ofunato Fish Market -

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### 1. Introduction

As the international demand for marine products increases, exports expand, and concerns about the management of resources and sustainable fisheries grow, it becomes increasingly essential to improve hygiene and quality management in fishing ports, as well as the efficiency of and traceability of market transactions. While fishing ports and markets go about installing facilities and equipment for hygiene management in a systematic manner, however, it is true that, aside from those in a small number of locations, transaction procedures remain utterly dependent on handwritten paper forms such as order slips. Therefore, it is necessary to promote the computerization of these facilities, particularly for the handling of market transactions. This will be beneficial for reducing time and labor, as well as improving traceability and resource management. This report provides the results of a quantitative analysis of the benefits of computerization for operations of the Ofunato fish market as a case analysis.

### 2. Fish Catch Handled and Computerization in Ofunato

Catch handled in Ofunato has yet to recover to its previous level since the earthquake, but sales have matched or exceeded the pre-earthquake totals because of the upward trend in average price. Pacific saury and yellowtail, which make up about 40% of the catch in Ofunato, have seen sharp increases in average price, followed by mackerel. Nearly all of these are fresh when accepted on consignment, which is the same fashion as before the earthquake. As for the processing of the purchased fresh fish, however, the fraction passed on as fresh product, which has a higher average price, has increased from about 20% to about 40%. The sales volume and value of live fish have also doubled. Of particular note is that the increase in the fraction of pacific saury that is passed on as fresh product and the average price of these fish are driving up the average price in the overall market by themselves.

Ofunato, Miyako, Minamisanriku, and Choshi have been targeted for computerization of their market transactions. The staff in these markets create transaction slips on their tablet terminals, they can also obtain the results of their bids and auctions on the spot. Of particular note is that, in Ofunato and Miyako, besides bidding

electronically, buyers can access to data for incoming vessels and also can view the sales catalogue and their results on their own tablet terminals. Among them, Ofunato has long worked to streamline its market procedures by introducing PCs and other measures. This began in 2002, prior to the March 11, 2011 earthquake and tsunami (below, “the earthquake”). Once a transaction was concluded, the content of the handwritten transaction slip was copied onto an optical character reader (OCR) form that was read by the OCR to create an electronic form of the transaction. The present system was inaugurated in February 2016, subsequent to the earthquake and simultaneously with the installation of the facilities and equipment for hygiene management in the fishing port and market. This was the beginning of computerization of the bidding, auctioning, and other processes.

### 3. Method for Quantitative Analysis

**Figure 5** shows a scenario within which the benefits of computerization were examined. On the basis of this scenario, analyses were carried out for transaction procedures after monitoring the transaction procedures on site as follows:

- (Main market building – **Figure 1**) Oct. 16-18, 2018
- Four Internet Protocol (IP) cameras were placed in locations providing bird’s-eye views of the interior and exterior of the market, and their images were recorded.
- Observers’ records of visual observations and photographs of the interior and exterior of the site (south quay and its shed) were obtained for Oct. 19-20, 2018
- Observers’ records of visual observations and photographs of the site were obtained

The following is the schedule for most tasks in transactions in the main market building during the peak season:

Opening	01:30
Acceptance of consignments begins	03:00
Bidding and auction begin	06:00
Creation of invoices & sales announcements	10:00 – 10:30
Publication of invoices & sales announcements	13:00
Verification and updating of market data	14:00
Close of business	14:00 – 15:00

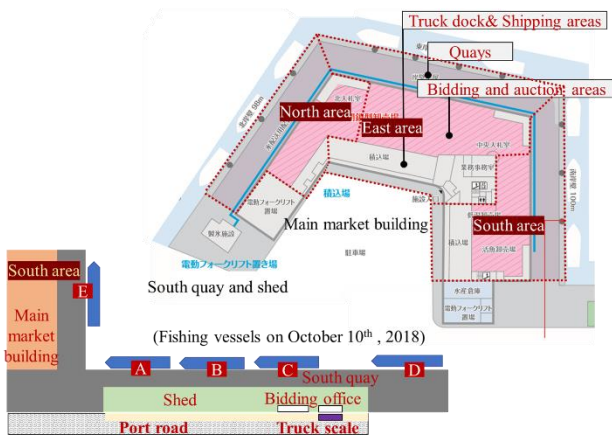


Figure 1 Main market building and south quay.

#### 4. Results of Monitoring

Figure 2 shows the numbers of the various classifications of users of the main market building (Oct. 18) at the quays, bid and auction hall, shipping dock, and other locations. Accepted consignments increased as the time for beginning bidding and auctioning drew near. Products on which bids had been accepted or which had already been auctioned off were transferred sequentially to their buyers and taken away. Bidding and auctioning finished before noon and the lights in the market building were turned off after noon. The floor and the materials and equipment were washed at the end of every step preceding

acceptance of consignments, namely, after unloading, acceptance, weighing, bidding and auctioning, and shipping. The invoices and sales announcements were published at about 14:00, an hour behind schedule. The entrances and exits of the main building were cleaned and the building was locked up between 13:00 and 14:00. The building was closed at 14:20, and all the staff had departed by 15:00.

The scheduled time for bids in the south quay and shed is 07:00. On Oct. 19, bidding began at the scheduled 07:00, but as a trawler docked at 07:45, bidding was restarted after 08:00. Around 06:30, the staff had begun to take samples of catch from the holds of the already-docked trawlers before bidding and were examining them to classify the fractions of each graded volume. The weighing time on the truck scale was short, about 1 minute per load. The scale was used shortly before unloading began, and stopped soon after the last unloading finished.

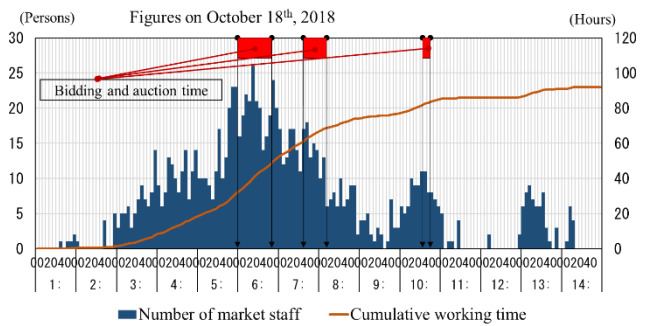


Figure 3 Number of market staff and their cumulative working time at the main market building.

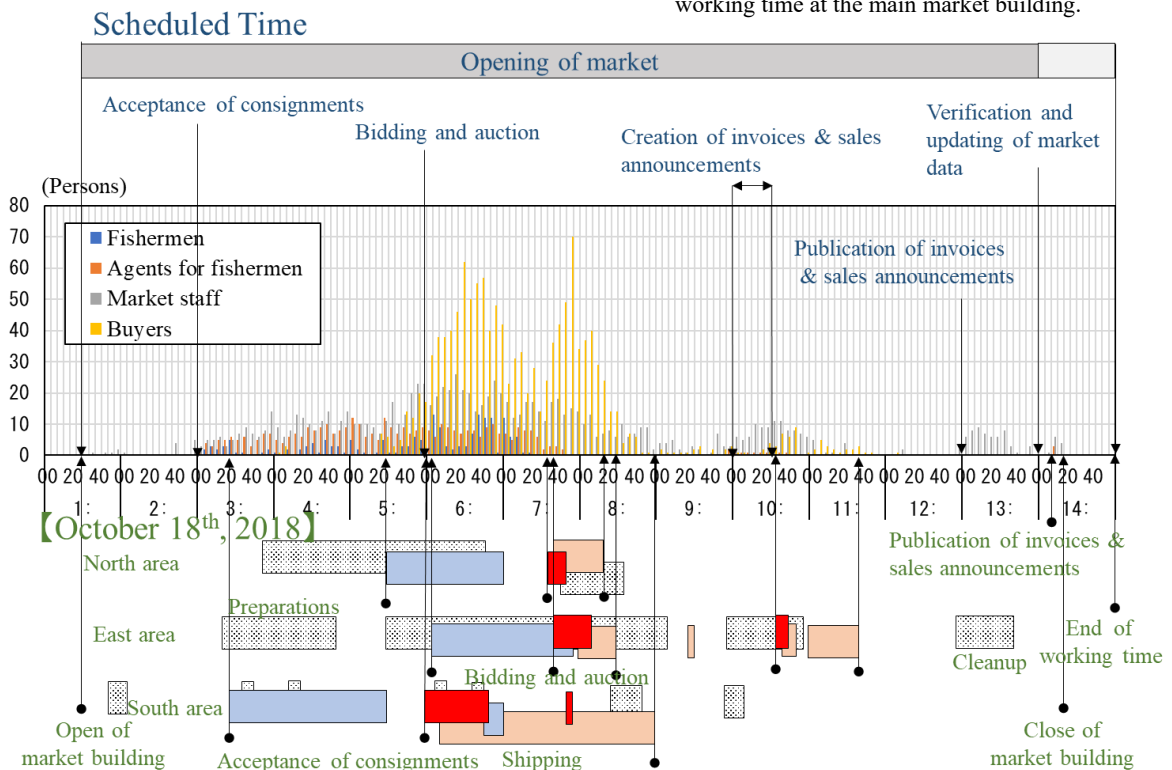


Figure 2 Number of users of the main market building.

**Figure 3** shows the variations in the number of the market staff involved in transactions and in the length of cumulative working time at the main market building. The same data are also graphed for the south quay and the total working time involved in transactions was calculated.

- (a) Working hours at the main market building  
Average on Oct. 18-19 → 95 hours
- (b) Working hours at the south quay and its shed  
Average on Oct. 20-21 → 39 hours
- (c) Working hours in the bid office 3.5 hours
- (d) Working hours on invoices and sales announcements  
5 hours
- (e) Night duty hours (excluding daytime work)  
15 hours
- (f) Working hours in facilities and equipment management (related to hygiene facilities)  
18 hours
- Total of (a) through (e) (transaction procedures)  
158 hours

**Table 1** provides a comparison between the current and the pre-earthquake work times for the personnel assigned to these facilities for work on transactions. According to interviews with the personnel about work times before the earthquake, the scheduled work times are about the same. Currently, the conversion of sales results to electronic form by OCR is no longer necessary (2), but there is now additional work in the management of the facilities and equipment (1). The number of the assigned personnel has slightly decreased from 22 to 20 persons, and the total scheduled work time has shrunk by 12% from 213 to 188 hours. The time spent in actual labor has fallen from 213 to 158 hours, a 26% decrease.

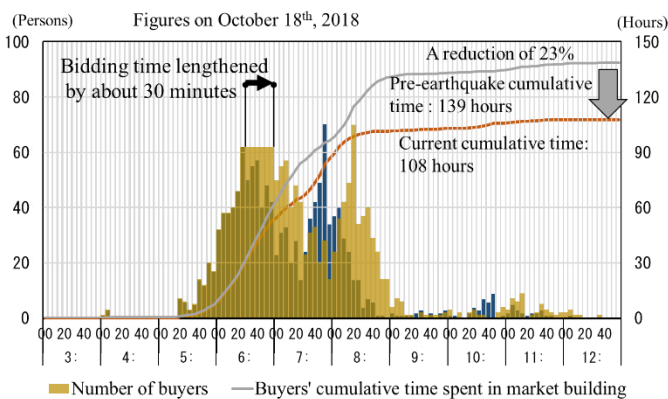
Changing over to electronic bidding has allowed automation of the selection of winning and losing bids and amounts of product sold (this includes a verification step for the bidder) immediately upon the opening of the bids. As a result, not only have the two workers in the bid office been reduced to a single worker, the average time from the beginning of bidding through the deadline to the announcement of auction results has been cut from 26 minutes to 12 minutes, saving labor as well as time.

Additionally, the time for a single round of bidding for fresh fish in the morning had been shortened by about 14 minutes by the introduction of electronic bidding. Since

bidding normally required at least two rounds in the morning, that time had been reduced by about 28 minutes from the time before the earthquake. Thus, bidding time could be said to have been shortened by about half an hour.

**Figure 4** shows an estimate of the savings in the buyers' time spent in the main market building (for purchase), due to this 30-minute reduction. Interviews with buyers have revealed that they left work for the main market building at the same time as before the earthquake, but they have pointed to several improvements that have resulted from the computerization of the market transactions. For example, they noted that required information can be obtained as needed, and that it had become easier to plan purchases, obtain shipping after purchases had been made, and plan production at processing plants. They also said that the time required from initiation of bidding to the auction results had been greatly reduced. Thanks to this, they were able to return to their employers about 30 minutes earlier than before.

This shows a graph of the number of buyers and cumulative time spent in the market on Oct. 18 overlaid with a graph of bidding time lengthened by about 30 minutes for sale of fresh fish (fish in boxes). The current figures for the numbers of buyers and the cumulative number of hours in the main market building are compared with the pre-earthquake figures in **Table 2**. The time spent per buyer (purchase time) was reduced by between 24 and 30 minutes (20–25%) compared with the pre-earthquake time.



**Figure 4** Number of buyers and their cumulative time spent in the main market building (at present and before earthquake).

**Table 1** Comparison between the current and the pre-earthquake working time for the personnel assigned to the market transactions.

	Changes	at present		before earthquake	
		Assigned personnel and scheduled working time	Assigned personnel and scheduled working time	Assigned personnel and scheduled working time	Assigned personnel and scheduled working time
Changes in assigned personnel, scheduled working time and actual working time	±0 persons -3% -17%	22 persons 206hrs	22 persons 213hrs	22 persons 213hrs	22 persons 213hrs
Changes in assigned personnel, scheduled working time and actual working time except for those of (1)	-2 persons -12% -26%	20 persons 188hrs 158hrs	20 persons 188hrs 158hrs	22 persons 213hrs	22 persons 213hrs
(1)	2 persons 8%	Management of facilities and equipment related to hygiene facilities of the market	2 persons 18hrs%	-	-
(2)	-6 persons -25%	-	-	Conversion of sales results to electronic form by OCR	6 persons 54hrs

Table 2 Number of buyers and their cumulative number of hours in the main market building (at present and before earthquake).

Items	Changes	at present	before earthquake
Octoebr 17th, 2018			
Number of buyers	±0	74 persons	74 persons
Cumulative time spent in market	-21%	117hrs	149hrs
Spent time per buyer	-20% (-24min)	1.6hrs	2.0hrs
Octoebr 18th, 2018			
Number of buyers	±0	70 persons	70 persons
Cumulative time spent in market	-23%	108hrs	139hrs
Spent time per buyer	-25% (-30min)	1.5hrs	2.0hrs

### 5. Discussion of Procedure of Analysis

Figure 5 compares the scenario imagined at the beginning of this report with the actual findings in the Ofunato market. It was proved that the computerization is conducive to saving labor and time in the market transactions. On the purchaser side, benefits could include easing purchase, transportation, processing, and production planning, as well as reducing the purchase time. Although it was only a case analysis, it was the first-ever quantitative assessment of the computerization of market transactions. It is hoped that this procedure will prove itself in other analyses of benefits versus the expense of computerization in the future, and that it will eventually

promote further computerization in other fishing ports and markets.

The computerization of the market transactions can be expected to revolutionize work style in fisheries. Its most expected benefit might be matching employee work schedules to the actual tasks involved in market transactions and reducing both the number of workers needed and the scheduled work time. The procedures of its quantitative analysis are as follows:

- 1 A scenario for realizing benefits of the computerization is conceived, referring to interviews with the staff, buyers and other personnel, and statistics regarding to the fish handled.
- 2 Through the monitoring of the market transactions, the actual number of assigned personnel, work schedules, actual time spent working, bidding and auction time, time from acceptance of a consignment to shipment, and time spent by buyers in the market facilities, are clarified.
- 3 The monetary values for the reductions in personnel and time are estimated, and the benefits over the expected lifetime of the facilities are calculated.

### 6. Summary

Although it was only a case analysis, it was the first-ever quantitative assessment of the computerization of market transactions. We expect further carrying out similar analyses in other advanced markets in the future and also look forward to improving the accuracy of the aforementioned analytical procedures.

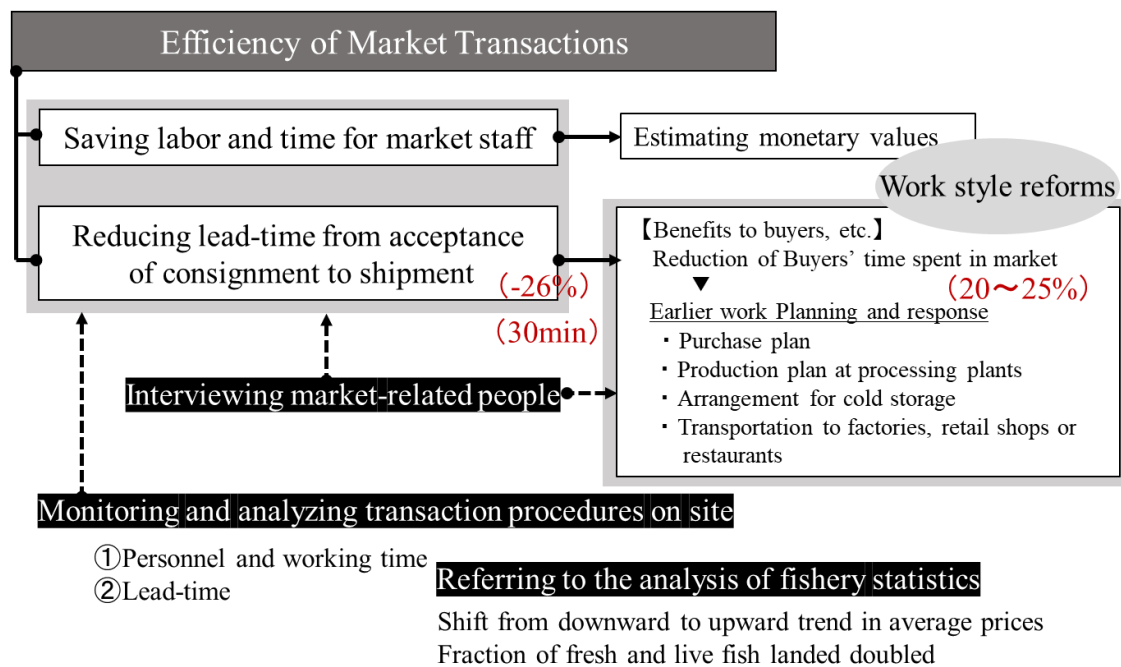


Fig. 5 Supposed scenario for quantitative benefits of digitization and computerization for operations of the market transactions.