

Technology Adoption in Oyster Processing: A HACCP Stimulus?

Roger A. Hinson and Daniel B. Whitley

While reports of illness and even death associated with raw oyster consumption have raised serious food safety issues, the vast majority of consumers suffer no ill effects from consumption (Park et al.). Two of the leading pathogen problems are *E. coli* and *Vibrio vulnificus*. *Vibrio* is the more serious threat to human health. The case-fatality rate for *Vibrio* septicemia does exceed 50 percent in compromised persons, but the overall illness rate is approximately 0.5 per 1,000,000 in the Gulf Coast population. Illnesses and infections associated with *Vibrio* are most prevalent during the warmer months, primarily April through October. Louisiana harvested 60 percent of its 1994 total oyster supply during these months. *Vibrio* became an important concern for the Louisiana oyster industry when the rising number of illnesses spurred the FDA to require warning labels on all raw oysters harvested from southern waters. Publicity attending this issue affected consumption levels.

Seafood safety has long been a public health issue, and there have been many government and industry efforts to assure safety. Competing approaches and regulatory agencies were reconciled when an Interstate Shellfish Sanitation Program (ISSP) and its Model Ordinance became the effective rule. In the oyster industry, HACCP compliance in the form of a Model Ordinance became mandatory on December 18, 1997. Individual firms have been affected by the additional costs imposed by these regulations.

Alternative implementations of HACCP systems, in addition to the guidelines provided by ISSP, are possible, and individual processors can determine the system that best fits their situations. Alternative HACCP practices used in the oyster industry have not been identified and published, nor have

kinds of costs involved or the levels of costs incurred by firms been documented. Additionally, the alternative marketing opportunities that may be derivatives of food safety publicity have not been investigated. In this report, we summarize costs by traditional fixed and variable classifications and evaluate those costs and HACCP implementation in general to suggest whether there are implications in terms of technology adoption.

The Model Ordinance consists of Critical Control Points (CCP) at receiving, raw product storage, processing, finished product cold storage, and shipping points. At the receiving CCP, verification that oysters were harvested from government-approved waters occurs before they are accepted for processing. The raw product storage CCP requires that oysters be placed in proper cold storage within two hours and that temperatures be monitored by time-temperature recorders to verify continuous compliance. Processing activities may include washing, grading, and/or other activities. The CCP governs time outside refrigeration during these activities. Additional CCPs assure that the packaged product is properly stored until shipment, and that temperature is maintained during transportation to customers. Individual firms have been affected because these regulations often impose additional costs.

Literature Review

Costs of HACCP systems for seafood processing were distinguished by kind in Massachusetts (Colatore and Caswell, 1998). Costs were categorized as total costs, cost of implementing minimum requirements, and incremental costs attributable to the FDA regulation. Cost data were collected from eight processors of breaded fish in Massachusetts through personal interviews with quality control personnel. Cost categories for labor and other expenses included plan design, training, internal training costs by whether the training occurred during or outside the regular processing schedule, control and record-keeping costs, monitoring costs (including lab equipment), purchases of safety-related equip-

Roger A. Hinson is associate professor, Department of Agricultural Economics and Agribusiness, Louisiana Agricultural Experiment Station, LSU Agricultural Center, Baton Rouge, LA. Daniel B. Whitley is economist, USDA/ERS/MTED/EAME. This paper has been approved for publication by the Louisiana Agricultural Experiment Station as manuscript number 00-05-0238.

ment, corrective action costs, new personnel costs (including training and wages), review costs, sanitation costs, and validation costs.

A study of HACCP regulation impacts in the catfish industry was conducted by researchers at Mississippi State University (Herrera et al.). Three catfish processors were categorized by size (large, medium, and small) and by level of complexity (the number of product lines handled). Cost categories used were similar to those specified above, and included training, record-keeping, receiving, metal detection, food contact surfaces, hand sanitizing, and adulteration prevention. Results showed that the large processor incurred the highest total costs, but per unit costs declined as expected. Outside the seafood industry, cost information has been reported for HACCP plans in the meat and poultry industries (Roberts et al., 1996). Estimates suggested that small plants would be at a cost disadvantage on a unit basis. Costs and benefits of implementing a HACCP system in the pork processing industry were evaluated (Jensen and Unnevehr, 1998). The cost function was upward sloping for microbial pathogen reduction. These interventions to improve safety were less than 2 percent of total pork processing costs.

Methodology

This study used the case study approach to collect costs incurred in HACCP implementation. A descriptive study seeks answers to questions such as "who" and "where" or derivatives such as "how many" and "how much." This approach is appropriate given the meager volume of study of either HACCP implementation or the oyster industry. The study used a multiple-case, embedded design. Multiple-case designs follow a replication logic, where each case either predicts similar results or produces contrasting results for predictable reasons. The unit of analysis, the implementation of the HACCP program, is embedded within the firm.

Case Study Protocol. The basic questions of the study related to (1) the firm's perception of the seriousness of the *Vibrio* (and other food safety) problems, (2) how the firm had responded to this problem at the product handling and marketing levels, and (3) the approach used to implement the HACCP.

An expert panel was assembled to assist researchers in the selection of processors for inclusion in the study and in improving the research instrument. Factors affecting data collection included a geographically isolated oyster processing industry where firms had operated

without close scrutiny. Economic forces, including regulation, have changed the industry and caused some exit from the industry and close guarding of proprietary information. In addition, the integration of HACCP regulations is unique to the firm. The personal interview case study approach was chosen to capture the qualitative nature of HACCP program implementation.

Firm Selection. The target oyster processor was a firm that performed several, if not all, the following functions: receiving at the dock, transporting to the processing area, cool storage, cleaning/size sorting, packing for half-shell market, shucking, cool storage of packed product, and outbound shipment to customers. The Department of Health and Hospitals (LDHH) is Louisiana's agency responsible for maintaining the shellfish sanitation program and for the issuance of permits to operate.

These permits (142 firms had permits in 1999) are given only to processors who are in compliance with the existing shellfish sanitation program. However, the number of firms targeted by this project was much smaller, and many firms on the list did not meet the criteria. They were non-processors, such as restaurants that are required to have HACCP plans because of their intra-firm distribution activities. Others, according to the expert panel, were fishermen only, while still others were no longer active processors. Based on its knowledge of the industry, the panel's opinion was that about 20 of these processors met the research criteria.

The panel also provided guidance on firm size, processing technology, and geographic location, three criteria thought to be possible bases for variation in kind of HACCP program adopted. Firm size categories selected were small, medium and large, and were defined by the panel. The industry's overall technology range was not thought to be large, but a few larger operations were identified as having unique technology or with procedures beyond the minimum HACCP requirements. Finally, three production/processing zones along the Louisiana coast were identified by the panel. Processors were to be representative across those factors.

Data Collection. Many firms refused to participate, or agreed to respond but were always too busy to keep appointments. As a result, the study's scope was reduced to four respondents. They included the two high technology firms and two other firms thought to be either intermediate or large in size. The firms were located in the state's central and eastern regions.

The HACCP coordinator, plant manager, or other employee identified as the knowledgeable individual within the firm, was interviewed. During the field visits, data were collected concerning each firm's HACCP system and related costs of implementation and operation. Costs accepted as HACCP-related were those additional costs incurred in the effort to comply with regulations, above the usual costs of operation. A flexible time period was used to determine whether costs incurred were HACCP-related. Many processors had been involved in development of the model ordinance, so they were aware of changes that would be required. Some of these processors already had made significant changes in advance of the implementation date and were prepared for the deadline. Others still were attempting to become HACCP compliant after the deadline. Overall, processors incurred HACCP costs at different times. Our procedure attempted to capture appropriate costs over a reasonable period prior to and subsequent to the deadline, defined as costs incurred in the period starting two years prior to the deadline and ending one year after. Cost categories were those used by Colatore and Caswell. For costs that involved labor, hours required and the wage rate were collected.

The cost categories in this formula are descriptive, but are not particularly rewarding from an economic point of view. For that reason, they were re-classified into long run or investment-oriented costs and short-run or operating costs. These are presented as traditional fixed and variable costs. Design and training costs comprised most of the fixed costs because there was a learning phase and an attendant lump sum cost of the HACCP system. Variable costs were recurrent in nature. Wages spent on monitoring would be an example. Both kinds of costs are presented on a per pound of raw product basis. Fixed costs were not amortized.

Results

Results in terms of significant criteria, including size, management concern about illness-related publicity, added steps beyond the model ordinance, and cost (Table 1), are summarized below:

- Management of the largest firm was 'concerned' about publicity. It had an added step above the model ordinance requirement.

Table 1. Per Pound Cost of Implementing HACCP Systems, by Firm.

Size ratio	Kind of Cost	Cost per pound*
5.2 (largest firm)	Fixed	\$0.013
	Variable	\$0.024
	Total	\$0.037
3.5	Fixed	\$0.068
	Variable	\$0.048
	Total	\$0.116
2.4	Fixed	\$0.039
	Variable	**
	Total	\$0.039
1.0 (smallest firm)	Fixed	\$0.060
	Variable	\$0.003
	Total	\$0.063

* Firms reported a raw product volume that represented their weekly average for the year.

** This firm declined to provide hours and wage rate for comparable calculation.

- This second largest firm had been, and remained, 'very concerned' about illness-related publicity. Its HACCP plan followed the model ordinance exactly.
- The third largest firm expressed 'no concern' about publicity and its implications. It followed the model ordinance.
- Smallest among these firms in terms of oyster production, management of this firm was classified as 'concerned.' It had an added step in the HACCP plan.

Among these processors, the *Vibrio* situation was viewed as a serious problem. One processor in particular reported reduced sales in the period when *Vibrio* cases attracted an increasing level of publicity, and two others perceived a serious threat to the firm and the industry. One firm, however, stated that its sales had not been affected by the publicity.

There is no question that publicity about *Vibrio* negatively affected industry sales. In another sense, it presented opportunity. More than one processor indicated they had been approached by customers for verification of safety procedures. These proces-

sors, most of whom had cooperated with ISSC to test the utility of the evolving ordinance, had been able to use this fact to support their safety claims and allay customer concerns.

As another opportunity, individual HACCP programs have been used in individual firm marketing strategies. Food sellers, particularly restaurants, fear negative publicity. Given the situation in the oyster industry, many retailers became unwilling to take the risks associated with offering raw oysters to the public. And, since oyster demand was down, the product was replaced on many menus with other products. Still, the half-shell oyster is a potentially popular and profitable product. The technology developed by this firm has been the basis of a marketing program designed to increase its share of the raw oyster market. Though documentation of an increasing market share is unavailable, there is anecdotal evidence of the success of this program. The firm has captured a contract with a national restaurant chain that had dropped half-shell oysters from its menu. Overall, the firm's claim appears to be a powerful marketing tool to the retail trade. As a second example, another firm (smallest in terms of oyster processing, but a diversified seafood company) introduced a different technological innovation in the form of pressure treating oysters within their shell. This company argues that its process destroys *Vibrio*, but it does not verify this result through regular testing. Instead, this product is different because the pressure treatment opens the oyster shell, making shucking a quicker and easier process for either the restaurant trade or for the home consumption market. This latter quality is used in the firm's marketing and promotion efforts.

Implications

This research estimates HACCP implementation costs in the oyster industry and provides a qualitative representation of the industry's level of concern about this food safety issue. However, a particular contribution is the evidence that implementation of HACCP compliance through the model ordinance or through enhanced technology provided benefits to these firms that helped to offset the negative publicity. Management was able to address concerns about safety issues, and marketing programs have been built around technologies whose development was stimulated by this and other related issues. Cause and effect implications are not intended here, but a rebound in raw oyster consumption has coincided with the establishment and implementation of HACCP regulations.

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