Microbiological Indicators

Spoilage is caused by the action of microorganisms, so that the number of living microorganisms correlates with the degree of spoilage (Kimata 1936a, 1936b, 1936c). When fish meat is at the initial stage of spoilage, the number of living cells is around $10^6$ cm$^{-2}$ of skin; a strong odor of spoilage will be perceived when this number is $10^7$ to $10^8$ cm$^{-2}$. To count the number of living cells is complex and time-consuming, so it is not a practical method for estimating fish freshness.

Chemical Indicators

Researchers have proposed a number of chemical indices of fish freshness: volatile basic nitrogen (Tomiyama et al. 1952; Takase 1953; Kawabata et al. 1953a, 1953b); ammonia (Yamamura 1933; Takahashi 1935; Ota et al. 1952, 1954; Tokunaga et al. 1977); amines (Takahashi 1935; Tokunaga et al. 1977); volatile acid (Suzuki 1953; Asakawa 1953, 1954 1957b, 1959); pH (Yamamura 1936; Kawabata et al. 1952; Yamamoto et al. 1953; Miyake et al. 1952, 1954, 1955); buffering capacity of muscle (Suyama et al. 1958); and adenosine triphosphate (ATP) and related compounds (Saito 1961; Ehira et al. 1966; Fuji et al. 1966; Ehira et al. 1969).

According to detailed investigations of phosphorylation in animal muscles (Saito 1956, 1961; Jones et al. 1964, 1965; Burt 1968; Uchiyama 1970; Jahnnes et al. 1976; Numata et al. 1981; Yamada et al. 1981; Lee et al. 1982), the decomposition of ATP in the fish meat sets in after the death of fish, and adenosine diphosphate (ADP), adenosine monophosphate (AMP), and related compounds are generated subsequently according to the sequence shown in figure 1. In most cases the rate-determining step is from inosine to hypoxanthine or from hypoxanthine to uric acid, depending on the species of fish, and consequently inosine or hypoxanthine is accumulated with increased
storage time. The total number of ATP-related compounds is usually constant, so the ratio of inosine + hypoxanthine to the total number is defined as the K value (Arai et al. 1961).

\[
\text{K value} (\%) = \frac{\text{inosine} + \text{hypoxanthine}}{\text{ATP} + \text{ADP} + \text{AMP} + \text{IMP} + \text{inosine} + \text{hypoxanthine}} \times 100
\]

K value is the most reliable indicator for fish to be eaten or not to be eaten as sashimi, that is, raw fish, in Japan. In case of a K value below 20%, it is possible to eat the fish meat as sashimi. With K value of up to 40%, it is possible to eat the fish by cooking. Of course, above 40%, it should not be eaten.

These values fluctuate widely with the species tested, and the procedures involved are usually tedious and time-consuming. Moreover, postmortem change in fish meat is fairly complicated, as noted above. Therefore, it is difficult to determine fish freshness accurately by the single indicators proposed.

A more accurate indicator of fish freshness is the overall and enzymatic reaction attributed to the changes in fish freshness, because various reactions taking place in fish meat, such as glycolysis, ATP degradation, denaturation and degradation of proteins, and oxidation of lipids, proceed at individual reaction rates (Watanabe et al. 1987).

The solubility of protein in salt solution and ATPase activity of myofibrillar protein (myosin) are used as indicators for denaturation of the protein. These indicators are very important in surimi manufacturing.

3. INDICATORS AND METHODS FOR DETERMINING FISH FRESHNESS IN JAPAN

The methods used in Japan for determining fish freshness are as follows. (The asterisks [*] indicate products on the market.)

a. Judgment from a single component.
   - VBN (TMA, NH3) - microdiffusion method (Conway)*
   - Polyamines (histamine, cadaverine, putrescine) - HPLC*

K value
   - column method (ion exchange resin)*
   - enzymatic method--Oriental electric Co. Ltd.*
   - HPLC method*

b. All-round judgment
   - pH (ß-buffer capacity)
   - viable cell counts Biosensor
   - nondestructive biological sensor—Torrymeter*
   - electric resistivity
   - color, order, elasticity - organoleptic

c. Indicators for processing (especially, surimi)
   - water-holding capacity
   - Ca\textsuperscript{2+}-ATPase of myosin

d. Determination of K value with biosensor (Okuma et al. 1992)

A continuous system for determining fish freshness with double enzyme reactors was developed and applied to the determination of the freshness indicator \( K = \frac{[HxR + Hx]}{[IMP + HxR + Hx]} \times 100 \) in many types of fish, where IMP, HxR, and Hx are inosine monophosphate, inosine, and hypoxanthine, respectively. The system was prepared from two combinations of oxygen electrodes and reactors. One reactor for the determination of the total amount of HxR and Hx was packed with nucleoside phosphorylase (NP) and xanthine oxidase (XOD), immobilized simultaneously on chitosan porous beads. Similarly, another reactor for IMP, HxR, and Hx was packed with 5'-nucleotidase (NT), NP and XOD, immobilized simultaneously on chitosan beads. The system was prepared from two combinations of oxygen electrodes and reactors. One assay could be completed within five minutes. The system for determining fish freshness was reproducible within 2.1% (n=30). The immobilized enzymes were sufficiently stable for at least seven months at 4 °C. More than 200 samples could be analyzed in about one month by using these enzyme reactors. The results for fish meat (13 types) correlated satisfactorily with those obtained by liquid chromatography \( r = 0.989, \quad n = 253 \) or ion exchange resin column chromatography \( r = 0.973, \quad n = 50 \). These results suggest that the proposed sensor system provides a simple, rapid, and economical method for determining fish freshness (ki).

Figure 2 and figure 3 show the schematic diagram of the reactor system and the results obtained by the proposed sensor system, respectively. Figure 4 shows an article on the market: BIO FRESH.
Figure 2. Schematic diagram of the reactor system: 1. air, 2. buffer tank, 3. peristaltic pump, 4. injection port, 5. precolumn, 6. enzyme column: (co-immobilized nucleoside phosphorylase and xanthine oxidase); (co-immobilized 5'-nucleotidase, nucleoside phosphorylase and xanthine oxidase), 8. oxygen probe, 9. A/D converter, 10. computer, 11. recorder, 12. valve, 13. waste.

Figure 3. Correlation between K1 value of fish muscle determined by the enzyme reactor system and by the conventional LC method.

4. STYLE OF RAW FISH AND QUALITY CONTROL IN JAPAN

Figure 5 is an aqua-farm in Kagoshima Bay in Japan. Now 1.2 million tons of fish are cultivated in Japan (1989). This is equivalent to one-tenth of the total fish catch per year in Japan and is worth 5 billion dollars.

Fish meat after instant death can be eaten raw as sashimi. Flounder and sea bream are transported to an eating house as live fish. Flounder is eaten before rigor mortis, sea bream during rigor mortis, tuna and other fishes after rigor mortis.

Unfrozen and frozen fishes are used for sashimi or cooking. Of course, these fishes are used as raw materials for canned food and other fish products.
Figure 6 is a container for transporting unfrozen fish. After being caught, fish are stored at 0°C in the container and transported to local retail shops as they are. This container is still in the experimental stage.

Figure 7 is the frozen tuna at Tsukizi market. Buyers examine the quality of tuna from the cross section of tail portion. This is the actual determination of fish quality in Japan.
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Figure 7. Frozen tuna at Tsukizi market in Japan.
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MEASURING THE QUALITY OF SEAFOOD PRODUCTS: USING MICROCOMPUTERS AND STATISTICAL PROCESS CONTROL IN THE SEAFOOD INDUSTRY

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INTRODUCTION

There are many ways and reasons to measure the quality of seafood products. Using computers to assist in this monitoring and then reporting the information in a usable manner makes even more sense. The purpose of this paper is to discuss some computer aids to help seafood processors become more profitable, that is, to have better control over the production environment and, at the same time, keep buyers and government agencies satisfied.

Unfortunately, as a rule, the seafood industry is behind in monitoring the quality of its products and its production processes. Canners are the exception. The good news is that processing seafood is really no different than thousands of other manufacturing operations. There are lessons to be learned, and some of these other methods can be adapted to seafood. The size and location of the seafood processor do not seem to matter. Whether the facility is big or small, in a large city, small coastal town, or on fishing boats, the technology is there and, albeit slow in arriving to the industry, has already proven its value.

Some of the things described here are used on Golden Age Fisheries vessels and by the office staff to report to buyers prior to delivery.

WAYS TO MEASURE QUALITY

First, what is quality and why does it need to be monitored? Quality has many meanings to many people. Quality is the set of attributes or characteristics of a product that the customer needs. To keep a customer, you must satisfy the customer’s demands. Quality attributes for fish fillets might include color, texture, size, number of bones, and odor.

Traditionally, the measurement of quality is based on inspection of finished product rather than inspection of the product at each distinct processing step. Understanding the difference between these two methods is vital to improving quality attributes and being able to summarize these parameters for the customer.

FINISHED PRODUCT INSPECTION

Finished product inspection is based on a sample, and tests are carried out to try to detect if the product is good enough or if it is too bad. Sampling itself adds variability into this step. By chance a sample can be representative of the rest of the product or not representative at all. In any case, if a problem is found, such as there are too many bones in the fillets, the production effort was wasted. Instead of doing the processing steps right the first time to achieve optimum quality, the company made an out-of-tolerance product. The quality is already in the product and it is too late to change anything without cost.

If a problem exists, the focus then shifts to disposition. A good sales person can sell anything, but at what cost? The process from this point is filled with lost time, labor, and money. It would have been much better to have avoided these problems in the first place.

Finished product testing is not only inexact and too late in the process; it does not answer a number of other questions either. For example, during production of individually quick frozen (IQF) fillets, the number of bones per pound of product must be monitored. The customer will not accept more than one bone per pound. If during an inspection three bones per pound were detected, the only thing that is known is that the sample is out of specification. Looking at the result of the inspection does not tell where the problem occurred or if it is representative of the complete production.

Was it a candling line error by one person or by everyone? Did the automatic fillet machine miscut so badly that the best candling inspector could not have kept up with the flow? Were discarded fillets accidentally being packed in with the “good” fillets? If the problem was detected at all, the problem was in the box quickly and it is too late to fix it. Where do you sell this product? What about the money already invested?
In spite of the inherent shortcomings of this old system of inspection, many customers still rely on finished product tests because fish is treated as a commodity. To understand how a product will be seen by the customer, it is wise to carry out a minimum level of finished block inspections in the same manner as the customer.

Any company trying to make a new product should first get the customer’s incoming inspection form and follow it (for example, see figure 1.) The company should double check the procedures on a day-to-day and hour-to-hour basis. Some customer would like to see the results of the effort written down because it will reassure them that tests are being made and it saves them time in duplicating the same procedures (figure 2).

German whitefish buyers - like many companies here in the United States - rely upon finished product testing to determine the acceptability of numerous quality attributes. German companies use statistical tests such as a standard deviation of measurements. The results of these tests from the production plant are compared to those found once the product arrives in Germany. Information from both sources are also compared to what was done in the past from one supplier and several competitors. The historical statistical information provides evidence and a basis for comparison. Phrases like “Don’t worry about quality; everything is OK, we promise it’s good” are only empty words without the evidence. More important, more and more companies are refusing to buy from suppliers that don’t have hard evidence of what was produced in the plant.

In summary, finished product inspection in seafood is based on how many samples are examined, to get the best picture, many samples must be taken at an ever increasing cost. Years of experience have proven that finished product testing doesn’t work with seafood any better than it does with making ball bearings, car doors, or food for NASA. But for many years, finished product inspection was all that was used. Its practice still exists and will be with us in some areas (possibly Germany) for some time to come.

**STATISTICAL PROCESS CONTROL**

There is a better way than finished product inspection. The method is called statistical process control (SPC). The method provides statistics, information on the process in real time, or, evidence that satisfies the buyers. Importantly, this technique monitors the process to prevent a problem from being produced in the first place. It is not necessary to use a computer for this analysis, but a computer makes it much easier.

SPC emphasizes the measurement at key steps in a process to assure that the product will be good. An example is monitoring samples of fillets four times every hour from the candling line (frequency and number of fillets examined are based on a sampling table). If the count of bones goes over the specification number, the machines, the people, or other factors can be examined and the exact problem pinpointed.

A program of monitoring control charts is the fastest method of observing a process that is going out of control and determining when to make adjustments to the processing line. SQCpack, by PQ systems (available locally from Research Consultants, Seattle, Washington, 206-933-6663), is one of the most frequently used programs by seafood buyers and is very easy to learn and use.

**RUN AND DISTRIBUTION CHART**

A simple run chart may be all that is needed to see if your process is under control and to monitor the variance in the process. See figures 3 and 4.

By studying a control chart, another tool in the SPC armory, you can know the variability in a process over time. The major concerns (in this case defects of bones, fins, and parasites) are recorded, a summary is graphically plotted, and, if a problem occurred, the disposition of the product is noted. In the example, the product is being checked every 15 minutes and a total defect level of greater than two, is clearly visible. Action should be taken in such an incidence and the product reworked or downgraded.

Control charts can be made by hand or generated with software such as SQCpack if it is linked to an electronic balance or other measuring device, even calipers or light sensors.

The best place to use a control chart is in the factory, hands on. Because of the wet environment at sea, computers have not been very practical. The Marel scale/computer system that tracks product inventory and weight control is a notable exception. If computers are not practical, manual control charts, waterproof paper and a pencil will work and provide a wealth of information in a timely manner.
Figure 1. Mrs. Paul's /Campbell Soup raw product inspection format.
# Finished Block Inspection

**Type of Product**

**Production Plant**

**Technician**

**Date Inspection Done**

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<th>Date Code &amp; Period</th>
<th>Uniformity of Size</th>
<th>Uniformity of Weight</th>
<th>Dehydration</th>
<th>Foreign Material</th>
<th>Improper Fill</th>
<th>Bines</th>
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Points are deducted for variations in the quality of each factor. The total points deducted are subtracted from 100

To obtain the score, the total deductions must not exceed 15 points.

*Modified from: Mrs. Paul's/Campbell Soup Inc.*

Figure 2. Mrs. Paul's/Campbell Soup finished product inspection format.
Figure 3. Run Chart from SQCpack showing upper and lower control limits. This format shows the variability associated with production data.
Descriptive Statistics

All (n=1) 137 data points
Mean = 64.3 Min. Value = 47
Sigma Indiv= 7.8 Max. Value = 88
Est. Sigma = 4.1 Kurtosis = -0.151
Coeff.Var. = 0.1 Skewness = 0.360
Mean + 3s = 87.9 Normal
Mean - 3s = 40.8

Histogram

Figure 4. Distribution chart from SQCpack. Weights of Pacific Whiting fillets.
Control charts provide a basis for separating random from nonrandom events in a process. The goal is to have a production system that has inherent variation from random causes only. In addition, control charts help keep future production similar to what has been previously determined as acceptable. Consistency of product is very important to any of the buyers, whether the product is H&G rockfish, surimi, or fillet block.

Photocopying all the paperwork produced for the buyers or government agencies is not worthwhile because of the difficulty for someone to interpret the mass of excessive detail. Summaries, on the other hand, are valuable to many buyers of product. Using a data base program such as R:Base allows selection of defect levels, weight checks, microbiological tests, freezing temperatures, chlorine logs, sanitation checks, and many other tests that are important to buyers. This detailed summary information helps sales of seafood products fit with the buyer's needs and gives the level of confidence necessary to keep customers.

A relational data base allows selection of a specific day's production, product type, or another category that may be of interest to a customer or production staff. Selection of information does not overwhelm the client with inappropriate data, comments, or formats that the customer can not relate too. Customers appreciate a one-page summary and can always ask for more information if they need it.

Weight histories on a daily basis along with the rest of the processing information have saved thousands of dollars in product claims when small buyer samples come up with skewed sample weights that are not truly representative of the shipment. Daily weights also allow production staff to adjust their pack weights so that just enough product is leaving the facility, not too much or too little. The savings in this one area will, by itself, pay for the software and computer equipment many times over.

Summary information, with originals available as reference material, is also acceptable to the National Marine Fisheries Service in association with HACCP certification and will be acceptable to the Food and Drug Administration and other government agencies as programs are proposed at this time.
During the 1970s, the stocks on the Georges Bank fishing grounds, considered to be the richest fishing grounds in the world, were routinely attacked by 13 to 15 different nations, including the U.S. and Canada. The fleets of the U.S. and Canada were antiquated, mainly composed of smaller, wooden, “eastern rigged” side trawlers, while the foreign nations had large, well-supported fleets of steel-stern trawler-catchers and large factory trawlers and processors. Supply fleets of freighters and tankers allowed these fleets to stay on the grounds for periods as long as 9 to 12 months. The Magnuson Act became law in 1976, extending our territorial waters to 200 miles, thus effectively eliminating the foreign competition for our stocks.

During the remaining years of the decade, the U.S. fleet slowly converted to steel-stern trawlers as replacement vessels for the older wooden-side trawlers. Landings for a six- to seven-day trip to the fresh markets of 80,000 to 100,000 pounds were common. Generally, the industry was satisfied with the commodity mentality of the fishery. However, a small group became concerned that we were losing market share and that the resource would not hold up.

An industry group made up of harvesters, processors, and end users in the major markets of New Bedford and Boston came together with the New England Fisheries Development Association to plan a strategy for the future of the region’s fisheries. The major areas of concern were impending stock reductions and loss of market share caused by higher-quality imports from other countries in the North Atlantic basin.

Funding was secured through the Saltonstall-Kennedy Fund from the federal government, and the Quality at Sea Project was launched in 1981. It was felt from the outset that because this project came from industry, it must include active participation and support from across the industry. We needed to tackle the question of the quality of landed product and the impact of the entire processing and distribution chain on the ultimate quality of the product delivered to the end user, the consumer.

Oversight for the project through the trade association, its broad-based membership, and an industry oversight committee was an important component of the project’s management. Equally important was the project director, Captain Eugene Connors, a 25-year veteran of the New England groundfishery who came ashore to manage the day-to-day efforts of the project. A key to the team building and problem solving needed in such a project is the ability of the personnel involved to transcend social and personal differences between harvesting and shore-side production, distribution, and marketing of the product.

After an exhaustive literature search of methods and tools available, the participants set up guidelines for vessel participation. The project director enlisted the volunteer help of a high-line trawler and went to sea with equipment and methodology to implement the first phases of the product. Of major importance was this groundwork, which took a hard, long, and collaborative look at how we were doing the job of harvesting and of transporting catch to the market.

In addition, the harvesters themselves, from numerous vessels and feeder ports to the major ports in the region, were enlisted in the process. It was felt from the outset that this was an opportunity for industry to demonstrate its expertise. The empowering effect of this ground level participation generated further enthusiasm for the goals of the project. Often tips on handling that the “old timers” remembered or had passed on to their sons or mentors turned out to be helpful in planning the next steps of the project. The four major goals of the project were to (1) develop quality fish handling procedures, (2) demonstrate the benefits of those procedures, (3) establish a price differential for premium fish, and (4) reduce the labor intensiveness of producing such fish.

On board the vessels, attention centered on sanitation, work flow, and storage methods.
Traditional bulk storage of product in pens 10 to 12 feet deep was compared with shelving and short shelving the fish pens to reduce the weight on the fish. Boxing of fish on board rather than bulk stowage was demonstrated using side-draining, nesting plastic fish boxes from Norway and Iceland. The boxing demonstration was introduced on the volunteer trawler, the F/V Odin, sailing out of New Bedford, Massachusetts.

Early in the project, bled and boxed codfish was placed on the fish auction in New Bedford, which is a “blind” auction, not a display auction. Despite the high quality of the fish, it received a price below the market, which was a clear message from some of the dealers and processors opposed to change. Subsequent sales of fish landed during the remainder of the project were made “under the door” to processors involved in the project. (A display auction was established in Portland, Maine, after the conclusion of the project, and a premium was established there for boxed and bled fish.)

Using a combination of private, academic, and government agencies, we followed the fish produced under this project through the distribution system. We measured shelf life and quality attributes to document the advantages of special handling on board. A manual for use on board the vessels was written and distributed as was a processing manual during the years the Quality Project worked along the Massachusetts shoreline. National trade media, as well as local and regional newspapers, reported the findings of the project.

Project personnel didn’t confine themselves to the trip boats from the larger market ports (Boston and New Bedford). Numerous trips aboard other trip and day boats from the ports of Gloucester and Provincetown established a network of information about the advantages of the fish-handling systems approach demonstrated during the project.

Having set the stage along the Massachusetts shore, organizers extended the project farther east to include the Maine and New Hampshire coasts in 1984. Fish along those coasts were marketed in a different manner. Most ports, with the exception of Portland and Rockland, Maine, were located many miles from major markets in isolated rural ports. Fresh fish were typically landed at a small processing facility with whom the vessel captain had a marketing and supply relationship. Part of the catch might have been processed and part shipped to Boston, New York, and Philadelphia or other distant markets on consignment. Often the vessel didn’t learn the price of those fish until returning from the next trip, and recourse to pricing was limited.

The Maine Groundfish Association, in conjunction with the Maine State Department of Marine Resources, worked with the New England Fisheries Development Association to bring the project to their members. Again, this was a diverse group including vessel operators, processors, brokers, and regulators. This oversight group felt it was of the utmost importance that the project leader come from the harvesting sector so that little time would be wasted in presenting the program and it would be much easier to sell the program goals.

Using information and experience gained from the first stages of the project, the team selected several volunteer vessels from three ports to participate. These vessels reflected different market conditions and different styles of vessel management. One trawler was part of a large vertically integrated processing and marketing facility; the second reflected short-trip, independently owned vessels; and a third was a large trip boat that sold on the open market. Several processors actively worked with the project team, allowing sensory inspection of product after receipt either by vessel or truck and allowing the state inspectors to participate. At this time, additional laboratory testing was done to corroborate sensory grading of the fish shoreside.

During the later phase of the project, the goal of improving the quality of the landed product was further investigated by looking at three factors affecting the quality of the fish: enzymatic and bacterial breakdown after the fish has died and the effects of rigor mortis on the overall quality and shelf life of the product. Given a good sanitation regime in place on board, it was concluded that temperature control and proper handling were the most important factors affecting the quality of the product. Fish hauled up the stern ramp warm to the sea surface temperature. During the winter months in the Gulf of Maine, it is not uncommon to have surface water temperatures in the 40 degree range.

Traditional deck practices often leave fish on deck for extended periods of time, and because of the style in which they are moved from checker to checker, the fish are prone to bruising and increased deterioration from bacteria and enzymes located on the fish themselves. When fish can be rapidly chilled, their time in rigor mortis is extended; this extends
the shelf life of the product. Storage techniques also affect the overall quality of the fish. Bulk storage is the most damaging, followed by shelving. The best technique for preserving the inherent quality of the harvested product is boxing the fish at sea. The economic return to the harvester from improved storage methods can exceed 12 percent more landed weight from boxes than from bulk storage. Other containerized methods have merit as they too can reduce weight loss prior to landing the catch.

Solutions to the work flow on deck most often came from the crews themselves, and because of the capital requirements of large-scale cooling systems, proved to be a simple and low-cost alternative. A case in point: The use of wharf boxes with circulating seawater to keep fish wet and at a constant temperature greatly influenced the quality of the landed catch. In addition to preventing bacteria buildup, it kept the fish from bruising and allowed bleeding. Viscera, when removed, did not recontaminate the fish.

Shelf life studies indicated that properly handled boxed codfish could maintain its shelf life for up to 21 days from harvest.

By the end of the project in 1985, all the goals of the project had been met. Its findings were widely published in the trade press and were available in manuals. Personnel involved in the project spoke on many occasions to all sectors of the industry, from harvesters to processors, retailers, and food service operators. To this day, individuals are profiting from use of the systems advocated during the project. However, the industry as a whole failed to adopt many of the recommendations of the Quality at Sea Project.

With the HACCP-based system of seafood inspection about to become mandatory, it would be timely for the industry to revisit these fish-handling recommendations.
Quality Assurance: Concepts in Management
THE DEVELOPMENT OF THE FISH-FARMING INDUSTRY IN NORWAY SINCE 1980

The farming of salmon in Norway consists of many small units, with a relatively uniform technology based on floating dip net systems. Seven hundred twenty-nine units were registered in 1991. While 190 units are approved for smolt production, several of them are being integrated with the farming of fish.

Growth in Volume

The fish-farming industry in Norway, based on the farming of Atlantic salmon, developed during the 1980s from a relatively modest industry to a large, economically significant industry. Volume rose from approximately 7,500 metric tonnes in 1980 to over 160,000 metric tonnes in 1990, but has fallen to approximately 130,000 in recent years. Fish farming from 1983 to 1993 has been marked by steady growth up to 1987 and an explosive increase over the period from 1987 to 1990, which has been the peak year to date.

Such sharp growth has been possible because Norway has good natural conditions for fish farming and has had the necessary technology and expertise. Furthermore, active efforts have been made to market fish products. This development in the fish-farming industry has occurred despite relatively strict regulations governing participation and the size of units. Fish farming has been a licensed industry, and so not everyone who has wanted to has been able to set up in business as a fish farmer. There have also been stipulations on the expertise required (minimum final exam in aquaculture from upper secondary school or relevant professional experience), on who is entitled to own farms, and on the size of the farms, with an original maximum of 8,000 cubic meters that in 1988 was increased to 12,000 cubic meters.

Price Development

The price of Norwegian salmon increased in the first phase of the fish-farming adventure. It rose regularly and steadily up to 1985, when an average price was recorded of NOK 54.22 per kilogram of fresh salmon. Since 1985 it has been clear that Norwegian salmon is encountering greater resistance in the market, with increasing competition from other countries and other products in the food market. The sharp increase that has occurred in Norwegian production also means that since 1985 there has been more intense competition between Norwegian producers and exporters, showing clearly that salmon no longer sells itself. We are thus witnessing the transition from a seller’s market to a prolonged period in which there is a buyer’s market, and major challenges have to be faced in marketing and market development.

To counteract the effects on price of the sharp increase in volume, a scheme was established in 1990 under which a marketing cooperative, the Norwegian Fish Farmers’ Sales Organization (NFFSO), started to buy all surplus fish. This fish was frozen and stored at low temperature (-50°C) to be sold in the market during periods of reduced supply and so ensure more stable prices. In view of the size the “salmon mountain” gradually assumed, while individual fish farmers were not at the same time reducing their production, the existence of this stock of salmon in itself became a source of concern, creating uncertainty and low prices in the market. Finally the cost of this freezing scheme became so high that NFFSO and several salmon farmers went bankrupt in 1992. The stock of frozen fish from this period has now been sold.

Organization of Sales

Right up to the time of the bankruptcy in 1992, the sale, processing and exporting of
farmed fish was regulated\footnote{Royal Decree of 28 July 1978, pursuant to the Raw Fish Act of 14 December 1951} under the Raw Fish Act. This statutory protection was entrusted to NFFSO, whose task was to organize and check sales of farmed salmon and trout to approved exporters. This responsibility puts the sales organizations in the fisheries industry in a special position, on the one hand performing administrative tasks on behalf of the authorities and on the other attending to the interests of a group of fish producers.

After the bankruptcy, both direct and indirect sales were deregulated. Many people claim the bankruptcy came at an opportune moment, with the result that the adjustment to the European Economic Community (EEC) could be made less painfully. The system involving a dominant marketing cooperative in the fish-farming industry was claimed by many to be contrary to the market regime in the EEC; critics felt that it might therefore be declared invalid by the EEC, which has a system of voluntary producer organizations (PO). In practice, the discontinuation of NFFSO has implied that the old system of approving purchasers of salmon has been done away with, while a change in the export law has provided greater freedom for performing export services. Today, an export license is given on the basis of economic soundness rather than on performance in the market. The result is that there are now more exporters. This has meant the start of a certain amount of restructuring in the fish-farming industry. I shall return to this later in the article.

**MARKETING OF THE NORWEGIAN SALMON TRADEMARK UNDER THE DIRECTION OF NFFSO**

NFFSO showed itself early on to be a sales organization that differed from the other marketing cooperatives in the Norwegian fish-farming industry and played an active role in promoting the joint marketing of Norwegian salmon. In the traditional whitefish sector, the marketing cooperatives have had very little involvement in activities other than direct sale, that is, fixing prices, directing catches, and undertaking various inspection duties on behalf of the fisheries authorities.

Through the Market Council, a council made up of representatives of exporters and producers under NFFSO's management, NFFSO has worked towards the joint promotion and marketing of Norwegian farmed fish (generic marketing). The aim was to give Norwegian salmon and trout a profile as "the finest and freshest fish on the market" and establish this product as a trademarked product of high quality.

As part of this strategy, separate operational units were established in the main markets of France, Germany, Spain, and the U.S. The market offices conducted practical market work in the form of trade fairs, advertising campaigns, and direct contact with customers of Norwegian salmon exporters. The work focused on establishing the trademark and concept of Norwegian salmon in the market. A survey undertaken among importers and distributors of Norwegian salmon in the U.S. before trade restrictions were imposed on imports, shows that Norwegian salmon was regarded as the best quality and the best value for money (Olsen 1992).

The marketing effort on behalf of Norwegian salmon grew steadily from the time the Market Council was set up in 1979. The budget in 1979 was NOK 640,000, rising to NOK 62 million in 1990. It is clear, therefore, that the bankruptcy of NFFSO has resulted in a severe setback for the joint marketing of Norwegian salmon abroad. Marketing was financed by a compulsory levy on all sales of products through the cooperative.

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The dominant position Norway held in the total market for salmon meant that the marketing activity to some extent also benefited fish farmers in other countries. The problem with this type of marketing is that it is difficult to make the effect of the promotional work exclusive, so that when the customers have been persuaded to demand more salmon, it is not certain that they will demand salmon from Norway; they may just as well buy salmon from other producer countries, depending on availability and market price.

The marketing of Norwegian salmon has demonstrated how difficult it is to establish an exclusive trademark or concept unless the one who undertakes the marketing work also has responsibility for production and quality inspection as the individual actor in the system. It is easy to be wise after the event-certain
things that could have been done differently can readily be identified. For example, we should have registered the Norwegian Salmon trademark. Today we can see the results of not having done so: Norwegian salmon can be found on the menu in virtually every restaurant in the U.S., despite sales having almost completely ceased in 1991. By way of comparison, it may be mentioned that New Zealand has protected the Greenshell Mussels trademark with great success. We have witnessed the same development in Scotland, where the trademark has been protected through the introduction of a certification and inspection scheme for approved producers of “quality approved Scottish salmon.” Producers must be approved (certified) before they can use the trademark.

From the Norwegian point of view, the lack of supervision of individual producers and exporters meant that quality became uneven. Although the vast majority could still produce products of the right quality, it does not take many rotten apples in a barrel to spoil the overall impression.

The lack of supervision over the production and sale of farmed fish resulted in the products ultimately presented to the customer not always living up to the expectations aroused by our mass marketing efforts. To some extent this weakened trust in Norwegian salmon in the market. It has been particularly apparent that the quality of Norwegian salmon has dropped in periods of overproduction and tough price competition. When the authorities had in addition cleared the way for free exports, several unscrupulous actors entered the arena. Their entrance soon weakened the quality image of Norwegian salmon, which had been built through a long and laborious process.

The lack of supervision was not a problem just in primary production; it was just as much of a problem in the distribution chain through to the customer, where salmon of differing quality was sometimes mixed together and sold as “superior Norwegian salmon.” Nor was it difficult to get hold of Norwegian gill clips and attach them to fish of different quality and from different countries of origin. The “problem” of gill clips that are too solid has led, for example, to work in Scotland to develop a mark that falls off more easily and thus makes unauthorized reuse of quality marks more difficult. Workers are also examining ideas for the permanent labeling of individual fish, the use of bar codes, and so on.

QUALITY INSPECTION AND THE DEVELOPMENT OF THE STANDARD PRODUCT NORWEGIAN SALMON

The fish-farming industry decided on a strategy of supplying a raw material of the highest possible quality and thus making the product attractive in the market. In addition, the strategy involved supplying the product in large quantities.

The philosophy was to supply the finest and best fish, based on the ideas that “high quality will certainly find a market” and “high quality can be put to any use required.”

Superior Salmon

To safeguard quality, a relatively simple system for grading salmon in different quality classes was established in 1985: superior, ordinary, and production fish.

The grading system was made subject to public quality inspection and thus represented a minimum standard of quality it was legally permissible to put on the market. For many fish farmers, this unfortunately also became a maximum standard, and the aim became to produce as much as possible at cheaply as possible. There was thus no need to make an effort to produce a product that did more than satisfy the requirements laid down by the supervisory authorities. The proportion of superior salmon at first was around 90 percent but fell as the volume of production rose.

The grading system established was a rather simple and subjective one, with grading according to size and glossy surface, and to a lesser extent a grading according to raw material-based characteristics (fat, color, consistency). The emphasis was put on the external quality characteristics of the raw material (appearance) and less account was taken of the quality requirements necessitated by different products. The system therefore became vulnerable to variations in quality, while at the same time everyone was marketing the product under the common quality mark of Norwegian salmon.

To avoid the adverse effects of the trust placed by the market in Norwegian salmon, individual exporters chose to establish their own trademarks, such as Grand Nord, to ensure the necessary recognition and trust.

Development of Norwegian Salmon

As part of producing a standard product of high quality, NFFSO, in cooperation with the
trade organization, the authorities, and research councils, launched research and development programs such as New Fish (research into new species) and Healthy Fish (research to prevent and combat disease).

In addition, NFFSO launched its own activities with emphases on health monitoring, veterinary service, breeding, and computer systems for information and production control.

The purpose behind these activities was twofold: to develop fish with better quality characteristics and to make a greater commitment to training fish farmers in correct technology and processes for producing Norwegian salmon. In addition to this developmental work under the direction of NFFSO, Norwegian feed manufacturers and research communities made their own contributions to research and development, which has benefited the fish-farming industry.

Personnel were offered short courses in subjects such as breeding, feed and feeding, production and financial management, slaughtering, and quality grading. NFFSO also employed its own production advisers for the direct training of fish farmers. The training was organized through a separate foundation - the Aquaculture Training Foundation - which the sales organization established in 1988 in cooperation with the Norwegian Association for Aquaculture Research and the Association of Norwegian Fish Farmers. The objective of the foundation is to hold courses for fish farmers and foster closer cooperation between researchers and fish farmers.

The Fish Inspection Authority (Fiskeridirektoratets Kontrollverk) has also been used by the NFFSO in setting up the system and supervising the actual grading.

Towards the end of the 1980s NFFSO began working to a greater extent on questions relating to the standardization of production processes in the industry, for example, standards for the measurement of fat and color so that this could be quantified.

In connection with the freezing scheme, standards were drawn up for the handling and freezing of fish to ensure optimum quality and shelf life for the fish.

Developments in the market, with preparations for the establishment of a common European market with common rules for standardization and certification, also helped persuade NFFSO to give more thought to the certification of farms and businesses towards the end of the 1980s.

**From Quality Inspection to Quality Assurance System**

In 1988 the Good Fish Project was launched as a collaborative project between the authorities and the fish-farming industry. The aim was to bring together knowledge about quality work in one organization, spread this knowledge, and point out the need for research and development. The work was project oriented in the initial phase, with the emphasis on projects to improve the quality of Norwegian salmon and bring about a more uniform conception of quality among practitioners. In time, the Good Fish Project developed to become a driving force behind the establishment of quality assurance systems and certification in the fish-farming industry.

As part of the work to improve the quality of the Norwegian salmon product and to develop more customer-related product specifications for fresh farmed salmon, a wide-ranging customer-market survey was conducted in the period 1990 to 1992 under the Good Fish Project in the nine most important markets for Norwegian salmon (Koteng 1992). One of the conclusions from this survey, which was mainly conducted among importers, wholesalers, and smokeries, was that the five most important quality criteria are

1. freshness
2. color of the flesh
3. consistency
4. red gills
5. fat content

The results of the survey emphasize that customers in different countries and in different groups have differing tastes. This is reflected for example in different requirements for color and fat content, and thus differing assessments of whether Norwegian salmon is of good or poor quality.

An aspect that was emphasized as particularly positive in relation to Norwegian salmon is regularity of supplies. A negative aspect that was mentioned was that Norwegian salmon ought to be of more even quality.

The survey also confirms that European customers prefer Atlantic salmon to Pacific salmon.

This market survey supported NFFSO in its belief in the need to safeguard the quality of Norwegian salmon and to establish systems for quality assurance in the industry. Whereas in 1987 fish farmers were not at all receptive to the idea of introducing quality assurance
systems, by around 1990 the situation had changed substantially.

Plans were drawn up under the Good Fish Project and NFFSO to establish quality assurance systems in all Norwegian fish farms. To provide a basis for this plan, a systematic recording and description was made of all operating procedures in rearing, slaughtering, packing, and sales, in order to create standardized “model procedures” in the industry. The idea of a standardized product was also applied in the plan to introduce quality systems in fish farming.

The aim was to be able to certify all fish-farming businesses under NS ISO 9002. The possibility of developing a special quality emblem for certified firms that could be used in marketing was also discussed. This, as I pointed out earlier, was one of the shortcomings in the marketing of Norwegian salmon.

The aim was to implement a nationwide program, but because of the bankruptcy of NFFSO and inadequate financing, the project was launched as a trial project limited to the county of Hordaland. The results of the trial project will be the deciding factor in settling whether this program obtains the necessary funds to be expanded to other counties.

Because the quality program did not start until 1992, no conclusions can yet be drawn on how the work of establishing the quality systems has progressed. Our general impression is that the plan has focused too much on standard procedures in order to be more effective in producing a standard Norwegian salmon, and not enough on how to improve quality and how to bring about greater customer satisfaction.

EXPERIENCE FROM THE
ESTABLISHMENT OF QUALITY MANAGEMENT IN THE FISHERIES INDUSTRY IN GENERAL.

Quality Systems in the Fisheries Industry

The Norwegian Institute of Fisheries and Aquaculture has been involved in three different programs for the establishment of quality systems in traditional fish processing, prawn firms and fish farms.

The Norwegian Institute of Fisheries and Aquaculture has had a dual aim in these projects. First, we have had responsibility for establishing quality systems in individual businesses and for training consultants, who in the next phase are to take on responsibility for establishing quality systems in new businesses. The motto has been to educate the educators, whether they be consultants or internal quality coordinators in the businesses.

The Norwegian Institute of Fisheries and Aquaculture has also developed methods of finding an appropriate way of establishing quality systems in this type of firm and adapting the requirements of NS ISO 9002 to operational procedures in the fisheries industry. In addition, we have cooperated with a certification society to provide assistance with specialist knowledge of fisheries and take part in the certification work in businesses.

Method

The method that has been used is based on principles learned from experience. There is agreement that the employees are the most important element in a company’s quality system. We have therefore invested a great deal of effort in developing a method that can commit and motivate the employees. The projects have been developed by a team consisting of researchers, consultants, and educators (Robertsen et al. 1992).

The projects are divided into two phases. The first phase focuses on the motivation and participation of the employees, in whom it is important to activate the knowledge already present in the firm. The employees are probably the firm’s best “consultants,” and active commitment is therefore valuable in many ways.

Improvement projects also occupy an important position in the first phase. Because priority is given to identifying and solving problems, the employees will see positive things actually being done in the firm so that they are encouraged to make further efforts.

Phase two focuses on documenting the quality system of the firm. This documentation also provides a critical examination of existing routines and processes. They are changed if necessary before the system is finally documented in a quality manual. The firms usually need to be supported in the work of structuring the material in the quality manual.

The first production firm was certified for quality work under the NS ISO 9002 standard in April 1993. More firms will probably be certified soon. The first firm in the fisheries industry, the export business NORFRA, was certified in March 1993.

What Has Been Difficult?

Experience from the projects has been favorable, and they will therefore continue with the
next round, albeit with a few changes. First, it is essential that the senior management should sign contracts stating that they will participate fully in the development project. If not, the firm will be dropped from the project.

A second point is that in periods of high production it has been difficult to set aside the necessary time for quality work in firms. Third, more emphasis should be put on improvement work in businesses. To remedy this situation, it has been decided that most firms in the next phase, depending on size, will have to employ a full-time person for two years to manage and coordinate quality work in the firm. It is important that every firm have specific tasks to work on at an early stage and that requirements be set for improvement. In this way the process is set in motion and the firms feel that they attain practical results in a reasonably short time. Most firms that have achieved or are in the process of achieving a 9002 certificate have worked on quality improvement and quality systems for at least three years.

The process of establishing quality management systems according to an international standard will be useful in the overall work of establishing TQM. Quality management and possible certification of it will therefore be one of the aims in a firm’s development plans. The ultimate aim should be to have a production process and products that result in satisfied customers and satisfied staff, at the same time as the firm earns money.

EXPECTED DEVELOPMENTS IN SALES OF SALMON - THE NEED FOR QUALITY MANAGEMENT IN RELATION TO THE CUSTOMERS

The salmon market developed in the 1980s from being a relatively homogenous market with demand for a standard product distributed through long and complex sales channels. As the market reached approximately 100,000 tonnes in 1987/1988, it divided into two separate segments. In addition to the traditional channel, a segment became established with several product variants, increased processing, and the establishment of shorter and more specialized distribution channels.

The third stage is developing a more segmented market, a large number of products, trademarked products, and sales through a few specialized channels.

Requirements and Trends among Salmon Buyers

Developments in the retail market have resulted in supermarkets’ cooperating more closely with fish farmers and processors to define the best specifications and testing mechanisms to ensure that the requirements are met. The specifications are given in the form of manuals that are provided only to producers who enter the negotiation phase.

For supermarkets that sell their own brands, there should be the best possible checks on the source of the raw product. On the one hand, retailers in several countries are subject to strict legal requirements regarding product liability. On the other hand, the increased share of own brands makes it very important to check the quality of the products. This checking of the chain of supply has become visible through a close check of the selection of suppliers. It can therefore be expected that greater requirements will be set for formal quality approval according to an international standard in order to get into a negotiating position at all. Certification in other words is becoming a necessary, but far from adequate, condition for ensuring sales of products.

Product Specifications

Retailers set specifications for all the links in the chain of supply. They start with primary and secondary processing and go all the way back to packing and distribution. The specifications apply to the following areas:

- **Rearing**: operation of the farm, clean environment, feed, amount of biomass in the dip net, preparation for slaughtering
- **Raw material**: size, color, fat content, appearance, firm consistency, freshness, antibiotics, microbiological content, even quality
- **Processing**: hygiene, technical standard, handling, health and safety, chilling
- **Finished product**: taste, even size and clean cutting, slice thickness, packing, salt
content, skinning, boneless, no blood patches

**Delivery:** Fresh salmon must not be more than three days old when it reaches the retailer.

The retailers cooperate with a small number of suppliers, and the trend proves that it is worth maintaining a stable relationship with suppliers rather than change constantly and always be on the lookout for the best offer.

Salmon is changing in character, from a general commercial product of standard quality to a more differentiated product with many forms, qualities, and specifications. The price must be “right” and preferably stable over a given period. The main thing is to secure good and stable suppliers who can fit in with a given market concept or trademarked product.

Key actors in the industry believe that the future makeup of the industry will be as follows:

- Exporter-controlled fish farming: 10-20 percent
- Integrated firms (export-production-rearing): 20-30 percent
- Joint operation (fish farmers with joint production plants, purchasing, slaughtering, and so on): 40-50 percent
- Individual firms (independent): 10-20 percent

Since the export monopoly was discontinued, we have seen a development in the direction of larger amalgamations of fish farmers and exporters. These amalgamations establish their own quality systems and use quality management actively in the groups’ marketing. Development seems to be moving in the direction of statutory regulations that set certain minimum requirements a firm must meet with regard to health, environment, and safety while the detailed requirements on quality are developed in a close dialogue between the seller and purchaser.

Large customers in the European market will require a firm to have documented quality systems in order to enter into negotiations. If the group is accepted, the challenge will be to produce products according to detailed product specifications for customers. It is thus not sufficient to be qualified for the Olympic Games; you have to be properly prepared to win gold medals too.

We anticipate a stronger trend towards an increased number of products and consequently a need for producers who are flexible in adapting to different market requirements. Market orientation and marketing will therefore be key concepts in the 1990s.

**References**

NFFSO. Annual reports 1985-1990.
DEMAND FOR SEAFOOD QUALITY STANDARDS AND GRADES: THE CASE OF PACIFIC WHITING FILLETS

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Sherry Larkin
Department of Agriculture and Resource Economics, Oregon State University

INTRODUCTION
Quality assurance (QA) programs can generate several benefits to the seafood industry. These programs can result in higher product prices, increased sales, lower inventory costs, and reduced risk liability. They can help firms meet the requirements of national and international inspection programs in seafood quality and safety. QA programs also function as a framework for integrating marketing and production, as well as balancing costs and benefits. Such “marketing management” schemes can be helpful in developing production strategies that maximize industry objectives and opportunities.

Development of an industrywide quality assurance program has been proposed to improve market opportunities and reduce variation in Pacific whiting products. Past research has indicated that product consistency is important to industry buyers and may increase market prices, improve product reputation, establish brand loyalty, and provide market stability (Sylvia and Peters 1991).

The following paper summarizes some preliminary results from selected portions of an ongoing study sponsored by the Oregon Trawl Commission and the Oregon Department of Agriculture. The purpose of the study is to help Oregon seafood industries and fisheries management agencies develop optimal production, management, and quality control programs for Pacific whiting. Recently, over 100 surveys have been sent to groundfish industry members, including processors, brokers, wholesalers, and distributors. Survey questions were designed to delineate product quality issues and standards that affect fishers and processors in the Pacific whiting industry. The survey also attempted to explore the potential economic effects of adopting grading standards.

SURVEY/DATA DESCRIPTION
Three Pacific whiting product forms were included in this survey: individual quick-frozen fillets, headed and gutted, and surimi. Only the information obtained from the fillet surveys are discussed in this paper. The survey contained seven sections, which are briefly described below.

In the first section, respondents analyzed samples of frozen and thawed fillets that accompanied the survey. For individual frozen fillets, respondents scored the desirability of the package form, the general appearance of the fillets in the package, dehydration, and net weight. For the thawed fillet, respondents evaluated flesh color, appearance defects, fullness of flesh, texture, color, and overall consistency of product characteristics. The next section addressed the firm’s experience with Pacific whiting. The third section focused on quantifying the importance of different product characteristics when purchasing whiting fillets.

In the fourth section, respondents were asked to select levels of characteristics that would define a grade A and grade B Pacific whiting fillet product. Respondents also scored the importance of various federal, state, industry, and firm inspection and grading programs designed to maintain and improve consistent product quality. In the fifth section, a hypothetical market experiment was conducted in which respondents identified the relative importance of frozen fillet characteristics in contributing to firm profitability. The “market” consisted of eight Pacific whiting frozen fillet products that represented a different combination of quality for five characteristics. The last two sections of the survey asked questions about the market potential of different Pacific whiting products and general firm attributes.
SOME PRELIMINARY RESULTS

One important issue in developing a QA program is controlling variation in product characteristics. A seafood industry buyer may prefer to purchase a product that consistently has the same characteristics, even if the product has slightly lower average quality. However, maintaining consistency may be more important for some characteristics than others.

In the product quality section of the survey, respondents were asked to rank the relative importance of maintaining consistency for seven characteristics. Preliminary results show that net weight was the most important characteristic in maintaining consistency whereas texture was the least important (figure 1). The majority of respondents felt it would be unacceptable if 10 percent or more of the product packages were less than the stated net weight. Conversely, product remained acceptable if up to 20 percent did not conform to the stated texture. The five other characteristics surveyed had acceptability levels ranging from 10 percent to 20 percent, the order being bone count (similar to acceptability level of net weight), appearance defects, workmanship, shelf life, and color.

The remaining portion of the survey focused on the relative importance of different product characteristics for industry buyers and how these characteristics could affect profitability. Analysis was accomplished in three stages: (1) respondents developed two hypothetical grades by choosing a quality level for seven fillet characteristics; (2) results of a hypothetical market experiment were used to calculate break-even prices (see Sylvia and Peters 1991, for details of the analytical approach); and (3) a single optimization problem for a fillet producer was examined.

Stage 1: Respondents Established Grades

Each respondent specified his or her desired grade A and grade B product by completing the form shown in figure 2 for each proposed grade.

The results of the survey for the grade A and grade B products are summarized in table 1.

A total score for the grade A and grade B products was calculated by summing the scores for each of the six fillet characteristics that defined the grades. The score for each characteristic was found by multiplying the average score for overall product consistency by the average acceptability of the characteristic. Hence, the difference in scores between grades resulted from using the average acceptability scores at the 95 percent consistency level for grade A versus the 85 percent consistency level for grade B. The difference between total score for each grade was then used to explain the difference in estimated break-even prices determined from the hypothetical market experiment described below.

Stage 2: Hypothetical Market Experiment

The hypothetical market experiment provided information that identified the individual contributions of firm attributes and product characteristics to firm profitability. By
The Pacific whiting industry is concerned with developing grading standards for frozen fillet products that will meet our customers’ needs and requirements. You can help us by defining a grade A and grade B standard for Pacific whiting frozen fillets. Below are two identical listings of quality characteristics. Please indicate which options of the quality characteristics would best describe your definition of a grade A and grade B Pacific whiting frozen fillet product by circling one option per quality characteristic for both the grade A and grade B standards.

<table>
<thead>
<tr>
<th>OVERALL PRODUCT QUALITY CONSISTENCY</th>
<th>a) 99%</th>
<th>b) 95%</th>
<th>c) 85%</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEXTURE</td>
<td>a) Firm</td>
<td>b) Moderately firm</td>
<td>c) Soft</td>
</tr>
<tr>
<td>FLESH COLOR</td>
<td>a) White</td>
<td>b) Off-white</td>
<td>c) Light pink</td>
</tr>
<tr>
<td>SHELF LIFE</td>
<td>a) 18 months</td>
<td>b) 12 months</td>
<td>c) 6 months</td>
</tr>
<tr>
<td>APPEARANCE DEFECTS</td>
<td>a) None</td>
<td>b) Slight 1-3 defects</td>
<td>c) Moderate 4-5 defects</td>
</tr>
<tr>
<td>WORKMANSHIP</td>
<td>a) Excellent No imperfections</td>
<td>b) Good 1-2 defects</td>
<td>c) Fair 3-4 defects</td>
</tr>
<tr>
<td>BONE COUNT</td>
<td>a) No bones per 0.5 kg of fish flesh</td>
<td>b) 1-2 bones per 0.5 kg of fish flesh</td>
<td>c) 2-3 bones per 0.5 kg of fish flesh</td>
</tr>
</tbody>
</table>

Table 1. Composition of grades as determined by respondents.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Average Grade A</th>
<th>Average Grade B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Product Consistency</td>
<td>96.8%</td>
<td>86.1%</td>
</tr>
<tr>
<td>Texture</td>
<td>Firm to moderate</td>
<td>Moderately firm</td>
</tr>
<tr>
<td>Flesh Color</td>
<td>White to off-white</td>
<td>Off-white to slightly pink</td>
</tr>
<tr>
<td>Bone Count</td>
<td>0.5 bones/lb</td>
<td>1.5 bones/lb</td>
</tr>
<tr>
<td>Shelf-Life</td>
<td>12.7 months</td>
<td>9.3 months</td>
</tr>
<tr>
<td>Workmanship</td>
<td>Excellent to good (0.8 defects)</td>
<td>Good to fair (2.0 defects)</td>
</tr>
<tr>
<td>Appearance of Defects</td>
<td>None to slight (1.8 defects)</td>
<td>Slight to moderate (3.2 defects)</td>
</tr>
</tbody>
</table>

specifying a zero level of profit, we derived a “break-even-price” equation. Using this equation, we determined various break-even prices by specifying different levels of firm attributes and product characteristics.

In the “market” experiment, respondents scored the profitability of eight products on a scale of -10 (very unprofitable) to +10 (very profitable). The Pacific whiting fillets were assumed to be skinless, off-white, and frozen with the pinbone removed. The factors hypothesized to affect product profitability represented both the characteristics of the firm and the product. The products varied by grade, shelf life, supply availability, price, and texture. Firm-specific factors were annual gross sales, position in the marketing chain, and whether Pacific whiting is among the top three species (in volume) the firm handles.

The proposed equation was estimated using the statistical technique of ordinary least squares, and the results are summarized in Table 2. All factors measured were found to have a statistically significant effect on profitability except supply availability.
Table 2. Profitability of whiting fillets.

<table>
<thead>
<tr>
<th>Variables:</th>
<th>Coefficients</th>
<th>Absolute t-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade (1=A, 0=B)</td>
<td>5.05</td>
<td>4.84**</td>
</tr>
<tr>
<td>Price (U.S. dollars)</td>
<td>-13.63</td>
<td>4.85**</td>
</tr>
<tr>
<td>Gross Sales (10=above $55 mil., 9=$35-55 mil., 8=$20-35 mil, etc.)</td>
<td>-2.19</td>
<td>4.90**</td>
</tr>
<tr>
<td>Sector? (1=first receiver, 0=second receiver)</td>
<td>-2.37</td>
<td>1.60*</td>
</tr>
<tr>
<td>Handle Pacific Whiting? (1=yes, 0=no)</td>
<td>-4.30</td>
<td>2.94**</td>
</tr>
<tr>
<td>Supply Availability? (2 or 8 months)</td>
<td>0.21</td>
<td>1.20</td>
</tr>
</tbody>
</table>

Equation Statistics:
- Observations=62
- F=9.88
- Adjusted R2=0.54

To examine the effect that each factor has on price, we set profit at the break-even level (zero) and solved the estimated equation for price. Larger firms, represented by annual gross sales, were found to operate at a lower price, presumably because of the ability of larger firms to obtain volume discounts. As expected, second receivers had a higher break-even price because of the additional costs associated with their position in the marketing chain. Firms that have handled Pacific whiting break even at a lower price, presumably because of the historically poor product quality and reputation of Pacific whiting fillets. This tendency is consistent with previous research by Sylvia and Peters (1991), who found that the characteristics of Pacific whiting are perceived to be inferior to those of Argentine and Chilean whiting fillets. Fillet products that had a higher grade or longer supply availability received a higher price because these characteristics were more desirable.

In this analysis, one focus was on the effect on break-even price for fillet grade, given a firm’s position in the marketing chain and given whether the firm handles Pacific whiting. For moderately firm fillets with a nine-month shelf life, a five-month supply availability, and purchased by a buyer, the following break-even price equation resulted:

\[
\text{break-even price} = 0.93 + 0.37 \text{(grade)} - 0.17 \text{(first receiver)} - 0.32 \text{(Pacific whiting)}
\]

Using the above equation, we calculated several break-even prices. In figure 3, these prices are categorized by whether or not the firm has handled Pacific whiting and by its position in the marketing chain. Notice that the price differentials correspond to the coefficients in the break-even price equation, that is, grade A is consistently $0.37 more than grade B.

We were also interested in explaining the price difference of $0.37 attributed to moving from a grade B to a grade A product. The price difference can be calculated by the characteristics that defined each grade using the score differentials shown in table 3. This was accomplished by dividing the price difference by the total score difference to obtain the value of a unit of score. When the unit score value is multiplied by the score differential for each characteristic, of a grade A and grade B product, the value of each characteristic is obtained. This is shown in table 4. For example, the value of texture equals $0.0021 \times 19.

Stage 3: Grade Score Optimization

The goal of a firm is to maximize profits by increasing price while controlling costs. Switching production from grade B to grade A

<table>
<thead>
<tr>
<th>Species:</th>
<th>Buyer:</th>
<th>Prices: Grade A</th>
<th>Prices: Grade B</th>
<th>Prices: Average of Grade A and Grade B</th>
</tr>
</thead>
<tbody>
<tr>
<td>If firm has handled</td>
<td>first receiver</td>
<td>$0.81</td>
<td>$0.44</td>
<td>$0.63</td>
</tr>
<tr>
<td>Pacific whiting</td>
<td>second receiver</td>
<td>$0.08</td>
<td>$0.62</td>
<td>$0.80</td>
</tr>
<tr>
<td>If firm has not handled</td>
<td>first receiver</td>
<td>$1.13</td>
<td>$0.76</td>
<td>$0.95</td>
</tr>
<tr>
<td>Pacific whiting</td>
<td>second receiver</td>
<td>$1.30</td>
<td>$0.93</td>
<td>$1.17</td>
</tr>
</tbody>
</table>

Figure 3. Break-even prices for frozen Pacific whiting fillet.
Table 3. Grade scores by characteristics.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Grade A</th>
<th>Grade B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texture</td>
<td>79</td>
<td>60</td>
</tr>
<tr>
<td>Flesh Color</td>
<td>76</td>
<td>52</td>
</tr>
<tr>
<td>Bone Count</td>
<td>78</td>
<td>32</td>
</tr>
<tr>
<td>Shelf Life</td>
<td>75</td>
<td>49</td>
</tr>
<tr>
<td>Workmanship</td>
<td>77</td>
<td>50</td>
</tr>
<tr>
<td>Appearance of Defects</td>
<td>77</td>
<td>45</td>
</tr>
<tr>
<td>Total Score:</td>
<td>462</td>
<td>287</td>
</tr>
</tbody>
</table>

Table 4. Additional value of Grade A characteristics relative to Grade B.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texture</td>
<td>$0.040</td>
</tr>
<tr>
<td>Flesh color</td>
<td>$0.051</td>
</tr>
<tr>
<td>Bone count</td>
<td>$0.097</td>
</tr>
<tr>
<td>Shelf life</td>
<td>$0.055</td>
</tr>
<tr>
<td>Workmanship</td>
<td>$0.057</td>
</tr>
<tr>
<td>Appearance of defects</td>
<td>$0.068</td>
</tr>
<tr>
<td>Total additional value:</td>
<td>$0.370</td>
</tr>
</tbody>
</table>

may generate higher gross returns, but higher costs associated with producing grade A may actually make the product less profitable. If all costs were known, this decision would be straightforward, but many of the relationships between product quality and production costs are not yet established. Therefore, for this preliminary analysis, we assumed different cost functions to illustrate the different production decisions that a firm may face based on varying costs. The unit price is composed of a base price (the estimated grade B price) and a grade score value (the additional revenue received from producing a product with a higher score than a grade B product). The base price was calculated from the break-even equation, assuming that the firms are first receivers (first receiver = 1) and that they handle Pacific whiting (Pacific whiting = 1). The assumptions were made to specify a typical on-shore Pacific Northwest processor. The following linear price equation results:

price = 0.51 + 0.0021(score)

The hypothetical cost structures consisted of a base cost and two values associated with the grade score. Production of a higher grade, represented by a higher score, was assumed to increase costs. One grade score had a direct and constant (linear) impact on cost. The other was squared (quadratic) to represent costs that increase as score is increased. Three alternative cost structures were assumed (since actual costs were unknown) to emphasize how their differences affect production decisions.

The results in figure 4 show that different cost structures will influence which grade is most profitable. For example, production of grade A in example 1 would result in a loss of $0.03/lb; however, production of grade B would generate profits of $0.05/lb. Therefore, for the cost structure given in example 1, production of grade B would be the most profitable. In example 2, both grades could be produced and generate a profit whereas in example 3, only production of grade A will generate a profit. If cost information can be determined, cost equations like those shown in figure 4 can aid in making production decisions.

SUMMARY

The adoption of QA programs can be used as a mechanism to integrate marketing and production decisions. Responses from the ongoing survey indicate that net weight should conform to the stated package weight, grade A has a significantly higher price because of its more desirable characteristics, and those firms that have handled Pacific whiting in the past scored the hypothetical products lower because of past experience and reputation.

Before QA programs can be developed and implemented for Pacific whiting, market information must be incorporated with cost information into management decisions. The cost information must consider all supply-side issues, including how the fishery is managed. For example, the behavior of fishers will vary in response to regulations that can have important implications on the quality of fish delivered to the processor. Industry must also consider short-run versus long-run planning horizons. QA programs will incur up-front costs, but market benefits in the form of higher prices and increased sales may take a longer
time to generate, depending on marketing skills, promotional budgets, and the past reputation of the product. A successful QA program must incorporate both market and cost information and be a part of marketing and promotional efforts to expand market opportunities.

REFERENCES


QUALITY ASSURANCE AS A SOURCE OF FINANCING

Money is many things, but to the entrepreneur money is primarily a conveyor of information. And the essential information about which this person wants to be kept abreast is the level of satisfaction expressed by the consumer. The more money comes in - a steady flow - the better an indication that the firm is satisfying the needs of the consumer.

Information is a word that perhaps is abused today. Let us therefore leave the world of communication and directly enter that of finance. It might sound surprising at first, but this is the reality: the consumer is the primary source of financing for the firm. If the consumer is fully satisfied, the firm will not lack financial resources. Is this not the most significant confirmation of the overriding importance of quality assurance?

Quality assurance then is the ultimate source of financing. Indeed, we shall see that, even setting aside the role of the consumer, quality assurance is a direct and immediate -internal as well as external- source of financing opportunities.

INTERNAL FINANCING OPPORTUNITIES

It does not cost money to achieve quality. Rather, quality pays. It pays back the effort of its implementation, not only in increased consumer satisfaction and therefore a steady stream of incoming funds, but also as an array of cost reductions.

The Number of Refunds Is Nearly Eliminated.

With or without an explicit pledge of refunds, an angry customer does demand refunds and is often accommodated. Refunds are costly, not only for the waste they cause, but because most often they imply the loss of a customer. It is not only the present but the future level of sales that is implicated. Along the same vein, it is also whispered that with quality assurance even the number of law suits is reduced.

The Number of Rejects Is Reduced.

When all that needs to be done over the entire chain of production to assure the quality of the product is indeed done, one of the most evident benefits is the noticeable reduction in the number of rejects. Rejects are costly, not only for the evident loss of value, but also for the loss implicit in the inability to satisfy a potential consumer.

Morale Is Raised.

When refunds are nearly eliminated and the number of rejects is reduced, the morale of the employees is raised. Everyone within the firm, if not within the industry, soon knows of those results and is proud of being part of an outfit that does good work. The financial effects of this by-product of quality assurance might be hard to measure, but people work better and faster if they are proud of their work.

Expenses Can Be Eliminated.

Empire Fish Company, of Gloucester, Massachusetts, was the first seafood producer to implement the details of the quality assurance program developed by the Gloucester Laboratory of the National Marine Fisheries Service (NMFS) during the late seventies and early eighties. Knowledge of the quality of its product spread by word of mouth. The firm soon sold fish throughout the United States, and it did not spend one penny for marketing or advertising campaigns. This is an effect that can be easily quantified. And it does not mean that all marketing and advertising campaigns must be eliminated. Efforts to educate the consumer, for instance, would be highly useful. And financial resources devoted to this purpose could easily be found if the need for traditional marketing and advertising campaigns is reduced or even eliminated altogether.


There have been many attempts to quantify each of these fields. See, for example, Crosby
1979, pp. 119-126, or Gorga and Ronsivalli 1988, pp. 180-216. Unless figures are related to each firm, these cost estimates generally tend to have a mere theoretical flavor. But certainly it ought to be part and parcel of the statistical measurements relating to quality control to develop precise information for each firm on these effects. Firms that do take such measurements report consistently positive results. Fredrik Palsson, president of Icelandic Freezing Plants Corporation, put it quite well. As quoted in Bidner 1992, he said: 'We spend an awful lot of money on quality control. It's costly, but we get it back. We're essentially buying consumer confidence through our aggressive quality-control programs.' Here only two points need to be made. First, a program of quality assurance redoubles the effects of stringent quality control measures, because it covers not any one firm alone but the industry as a whole; the efforts of each firm are not negated but validated by the efforts of all other firms participating in the program. The second point is that a firm raises money internally by reducing costs and lowering expenditures. Since quality pays, in the microworld of each firm quality assurance is an implicit financing tool.

EXTERNAL FINANCING OPPORTUNITIES

Banks do not need hair-brained schemes. The nation does not need hair-brained schemes. The quality assurance program is a solid program. Another one of its hidden benefits is that it can become an explicit financing tool when put in relation to the outside world of finance. Any financial institution will more readily extend loans - at preferential rates - to firms whose costs are low and whose customers are satisfied.

Armed with this significant tool, it behooves the firm to explore all opportunities that exist in the macroworld of finance. Governmental and nongovernmental avenues have to be explored on a systematic basis. Here I review only a few such avenues.

I place most emphasis on two avenues that are little traveled by the seafood industry and are more often taken in other industries. These two avenues are employee stock ownership plans and access to national credit.

The World of Grants, Loans, and Subsidies

There is an entire world of grants, subsidies, and loans at preferential rates that is worth pursuing, provided one has the time and initial resources to pursue it. This is only another one of the reasons that organization, organization, and organization is so important. It is enough to start reciting the so-called alphabet soup of governmental agencies such as NMFS, with its Saltonstall-Kennedy funding program; the Economic Development Administration; the Small Business Association, with its Small Business Innovation Research program, administered by various agencies; even the Department of Defense - to realize how many opportunities are there to smooth the path of research and development in today's world of so-called mixed economies. Nor should one neglect local and state governments - and even private foundations. For many good reasons, one might be personally opposed to the existence of such a world, and yet two points need to be made. First, at a very practical level, one must remember that one can be put at a competitive disadvantage if the benefits offered by such a world are left by default to one's competitors. Second, many positive things can be said about effective, well-conceived, and well-managed R&D programs. Many projects might never be undertaken without such assistance; and once successfully undertaken, they function as insurance that the project is viable - hence the rush of applications from which, generally, the entire nation benefits.

The Employee Stock Ownership Plan

The employee stock ownership plan (ESOP) is one of the most important tools that can be used in the process of capital formation. Not unlike cooperatives, it is the only development tool that integrates economic and legal issues. Not unlike cooperatives, it is the only legal tool that addresses in advance the issue of equitable distribution of future ownership of the wealth that is being created. Unlike any other legal instrument, however, the ESOP is the only financing tool that allows for the deduction of principal as well as interest from the taxable burden of the firm. Congress allows for such a unique preferential treatment because, when it is well planned and implemented, the ESOP distributes a considerable number of benefits to all participants to the plan and to society as a whole.

Before looking at these benefits, let us become familiar with the mechanics of the plan itself. The literature on ESOP is vast and continuously growing; an updated reference list is maintained by the National Center for Employee Ownership in Oakland, California.
The Mechanics of the ESOP

The ESOP is a flexible legal instrument that must be designed to fit the particular needs of a specific firm. It is essentially a form of tax-qualified stock bonus plan. Thus the ESOP basically is a deferred compensation plan established for the benefit of all full-time and some part-time employees. The corporation contributes financial resources to this trust as a variable percentage of its yearly covered payroll. At present this figure is about 25 percent per year. It was the genius of Louis O. Kelso, its designer, however, not to leave this trust fund in a passive state but to conceive of it as an active entity. Thus was born the leveraged ESOP (Kelso and Adler 1958; and Kelso and Hetter 1967). Since the trust fund is fully tax exempt, it is the trust that applies for loans from financial institutions and repays the loans with the proceeds from the yearly contributions to the fund. The assets of the corporation also serve as guarantee of the repayment of the loan.

The Benefits of the ESOP

The benefits that accrue from an ESOP are better observed by singling out the benefits to each participant in the plan.

Stockholders

The stockholders of the corporation benefit from the creation of capital formation in a tax shelter environment. Certainly there is some dilution of their ownership, but this dilution refers to the ownership of future wealth - that wealth whose creation is assisted by the employees and is pursued under a favorable tax treatment. It is society as a whole that pays in the short run through the loss of tax revenues. But society too benefits in the short as well as the long run.

Society

The benefits that accrue to society stem from three major sources. The wealthier the employees become, the higher the individual income taxes they will pay when they withdraw their share of dividends or capital from the plan. And the wealthier employees and retired persons become, the less need they have for all sorts of welfare benefits. Thus, the ESOP tax deferral of today is compensated by the reduction in the welfare burden of tomorrow. The tax deduction is a true investment for the community as a whole. Society will also benefit from the rather immediate result of lower inflationary and deflationary pressures, because employees are more prone to lower their demands for wage increase in periods of inflation and to tolerate a greater level of wage reduction in periods of deflation.

Employees

Certainly employees can buy shares of stock today. But they have generally not done so in the past and are unlikely to do so in the future because to purchase shares of stock requires an amount of money that most employees do not have. With ESOPs, the corporation makes its credit status available to its employees, to borrow money from financial institutions. Employees-aided by tax deferments - in essence use their future profits to repay the loan and become owners of the stock. While at first sight there is only a shift between future wages and future ownership of stock, the changes are more fundamental than that. With the certainty of legal ownership comes a greater willingness to work hard and to see that co-workers work hard.

Stephen Covey (1989) distinguishes between production (P) and production capacity (PC), encourages building a balance between the two, and then (p. 58) points out, "You can buy a person's hand, but you can't buy his heart. His heart is where his enthusiasm, his loyalty is. You can buy his back, but you can't buy his brain. That's where his creativity is, his ingenuity, his resourcefulness."

"PC work is treating employees as volunteers just as you treat customers as volunteers, because that's what they are. They volunteer the best part - their hearts and minds." Employees who use their hearts and minds are more likely to observe and improve upon quality standards than employees who work solely for a wage. ESOPs are an internal insurance that quality standards will be the highest possible - from both a financial and a technological point of view. Is not that the beginning of wisdom concerning quality assurance? As Frank Foley (1981), an elder statesman of the fisheries industry used to say, "Quality fish, quality people."

ACCESS TO FEDERAL CREDIT

While it is true that quality pays, it is also true that - depending on the position from which one starts and the technology one wants to use - quality assurance requires variable investment sums at the outset. The money will
be recovered because consumers are ready to pay a higher price for seafood of assured quality, but the initial outlay is inevitable (Gorga and Ronsivalli 1988, pp. 189-192). Where will the money come from?

The traditional approach is to go to banks and other financial institutions for such funds. Banks and financial institutions then go to their depositors, pay going market rates of interest, and lend the money. This approach has two major limitations: the cost is high, and the availability of funds is generally low.

At times such as the present, such limitations are more severe than at other times. But they are always present. The question is, Is there any alternative to the prevailing state of affairs?

The alternative is this: rather than going literally to collect available savings from depositors and investors, banks and other financial institutions can go to the ultimate source of money, the monetary authority.

In the United States, the monetary authority is the Federal Reserve System. The Federal Reserve System is the ultimate source of money because it is the administrator of national credit: not personal credit or bank credit, but national credit. We individually create our own creditworthiness; we administer it and are responsible for it. So banks - and other financial institutions - are the creators, the administrators, and are responsible for their own creditworthiness. National credit is something different.

National credit is something that is created by all citizens of a country. All citizens contribute to the increase - or decrease - in its value. It is a common good. For additional characteristics, see Gorga 1991. And since it is a common good, it must be administered for the common good. It must be administered for the benefit of all. It cannot be administered for the benefit of a few people.

From this essential characteristic stem three criteria that must be met in the administration of national credit. These criteria were first enunciated in Gorga and Kurland 1987. National credit must be issued (1) for the creation of new wealth only, (2) for the benefit of all, and (3) at cost.

National credit must be used to foster the creation of only new real wealth. It is the creation of new wealth that directly or indirectly benefits all. Therefore, national credit must be issued only for the creation of new wealth. This criterion can also be justified on the basis of numerous other factors. If the issuance of national credit is accompanied by the creation of new real wealth, its creation will not spur inflationary tendencies. By definition, the issuance of national credit does stem deflationary tendencies. Hence new money created for the creation of new real wealth is stable money. By contrast, new money created for the purchase of consumer goods, goods to be hoarded, existing wealth, or simply paper wealth represented by government and corporate equity or debt is inflationary and hence unstable money. National credit must be issued for the creation of only real wealth.

National credit must be issued to benefit all. Again, there are many factors that justify the deployment of this criterion. If everyone benefits, an array of supreme values is set in motion. Justice prevails. The deleterious impact of envy is lessened. The need to satisfy material necessities assumes its proper role: it is placed neither too high nor too low on the scale of human requirements. With justice ruling society and a citizenry exercising a balanced core of values, not only the beneficial forces of the market are reinforced but even those of democracy. When negative forces are in check, positive forces are more liable to manifest themselves. The benefits of “good government” become widespread. Is not this what we all request from the administration of earthly affairs? Once all that is granted, the question becomes, How can the use of such a common good as national credit be administered for the benefit of all? In a society in which the law is supreme, the answer is surprisingly simple: the legal ownership of the wealth created under the wings of national credit must be as widespread among the citizens as possible. It can only be hinted here that, just as there are many forms of cooperatives, so conceptually there is a whole family of ESOPs - such as individual stock ownership plans, consumer stock ownership plans, or general stock ownership plans (see Bureau of National Affairs 1987, pp. 207-208).

National credit must be issued at cost. The Federal Reserve System prides itself on adding from its operations millions of dollars to the national treasury every year. While it is pleasing to hear that there are federal agencies that are concerned with the “bottom line,” the making of profit is not an appropriate function of government. As a result, national credit should be issued at cost. From the exercise of this criterion, it follows that the interest rate to be charged on loans that use national credit - even when a premium is charged to insure
against the risk of default - be in the 2 percent to 3 percent range.

The Legislative Authority

The legislative authority to use national credit along the lines pointed out in the previous paragraphs is already in place. In fact, it is part of the original legislation instituting the Federal Reserve System. The intent of the framers of this legislation is made explicit in paragraph 2, section 13 of the Federal Reserve Act of 1913, where it is mandated that the Federal Reserve System be empowered to discount eligible industrial, commercial, and agricultural paper.

The Political Will

The political will is the necessary ingredient that is missing for the use of national credit to become a common occurrence along the lines indicated above. In a democracy, the political will resides not in the politicians but in the people. If the people request that national credit be used in a certain way, it will eventually be used that way. This point is perhaps best clarified with a brief reference to the history of the Federal Reserve legislation.

A Brief History of the Legislation

The legislation on the Federal Reserve System was a product of the reform movement at the beginning of this century, and ultimately it was the outcome of the agrarian movement that was the hallmark of the second part of the last century. The agrarian movement had specific needs. The essential need was for short-term credit to tide over the farmers until the harvest.

A particular economic doctrine, the so-called Real Bills Doctrine, analyzed and codified those needs. But it did not extend the analysis to the needs of society as a whole - an industrial society at that. The needs of the industrial society vary a great deal and range from the overnight draft to the very long term. All those needs have to be accommodated if the national monetary policy is to be successful. The Real Bills Doctrine also placed no limitation on the use of the funds. Presumably, people could borrow money from the banking system for the sole purpose of accumulating supplies in order to jack their prices up exclusively for personal benefit. The third major limitation consisted of the disregard for the public good also from another point of view, the point of view of legal ownership of the wealth created with the assistance of public funds. There was no concern for enlarging the basis of the ownership of wealth and ultimately there was no concern for the very health of the market itself. A pyramidal market system, in which the ownership of wealth is concentrated in a few hands, can easily be toppled by manias, panics, and crashes, to borrow Professor Kindleberger's felicitous phrase.

With such weaknesses inherent in the theory, when the policy was implemented between 1914 and 1925, the results were unavoidably disappointing. The use of the discount window at the Federal Reserve System fell into disrepute, and funds from this source were thereafter only sporadically released (Burstein 1986, pp. 20-22 and 59-60).

There seems to be no reason why the errors of the past cannot be avoided in the future. Certainly, a new policy cannot be tainted by the errors of the past.

CONCLUDING COMMENTS

From the point of view of the consumer, the quality assurance program is a tool to assure the consumer of the quality of the product purchased. From the point of view of the producer, the quality assurance program is a tool to assure the producer of the financial viability of the product that is produced. Thus the loop is closed; consumers and producers both obtain what they want and what they unquestionably need.

In the long run, the quality assurance program is a tool of internal financing, not only because it lowers costs and expenditures for the firm but also because a product whose quality is assured commands a higher price than any comparable product. In the short run, however, the implementation of the quality assurance program might require considerable outlays of funds. When considering the technical requirements of the quality assurance program, one simply wants to obtain all the best that the technology can offer. As pointed out above, there are three major external sources of funding that need to be explored. One consists of all government programs assisting in the process of capital formation. The second is the use of employee stock ownership plans, since such plans are very well received by the conventional financial world today. The third is the recourse to the discount window of the Federal Reserve System. All three financial tools deserve to be researched, and if any of
them is found appropriate to the particular needs of an individual firm - or group of firms - at any particular time, all steps should be taken to adopt it.

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The settlers who populated the Tillamook Valley between 1855 and 1900 had some unique challenges to overcome. There were no roads for commerce. All supplies and cash sales moved by boat. Dairy was the only agricultural effort that was viable. Butter was the only dairy product they knew how to make. And sporadic transportation caused quality problems with customers.

In 1898, Peter McIntosh came to the valley from Canada to make Cheddar cheese. His knowledge of bacteriology and sanitation taught Tillamook dairy farmers how to make a good quality product that would withstand the variable delivery schedules.

Early dairy production was by private operators in competition with each other, but by 1909 many of them were operating as cooperatives, and Carl Haberlach, a young attorney, convinced ten of these small cheese plants to contribute $25 each and form a marketing cooperative. The Tillamook County Creamery Association was born.

Cheese, bearing the Tillamook brand on the rind, was sold throughout the west, but customers soon recognized a variation in the cheese from different factories and began to express their preference, affecting sales.

The most successful cheesemaker, Fred Christenson, was selected by Haberlach and approved by the cooperative’s board to work with each cheesemaker to improve the quality and consistency of Cheddar cheeses carrying the Tillamook brand.

Soon, Christenson and the other cheesemakers recognized that even if everything was done properly at the factory, many vats of cheese were less than desirable because milk coming from the farm was variable, from good to lousy.

Back to the board again, this time to hire a fieldman, Guy Ford, to work with the more than 800 dairy farmers, many of them milking only two or three cows. Some of the items that became important to the inspector were cooling milk after night milking, washing milking buckets every day, having milking pails tinned to remove rust, testing for flavors and sediment at the factories, and rejecting milk not meeting standards.

Quality soon began to show up in sales and, as sales improved, so did the price. As the price inched upward, it was possible to return a modest premium to the dairy farmers. Economics were established as a quality incentive by instituting a penalty system for substandard production. Many dairy farmers of marginal quality were encouraged to improve their practices or turn to other methods of earning a living.

In the decade between 1940 and 1950, most dairy farmers were forced to work at construction or lumber mill jobs to help support their dairies. Quality continued to improve from 1960 to 1970 as science taught dairy farmers more about controlling bacteria. Dairies continued to get larger and more advanced, and most dairy farmers now devoted all their time to the farm. Management practices improved as the grade A fluid milk market became a lucrative prize for those who could meet the more rigorous facility, equipment, and management requirements. A general attitude in the industry was that “manufacturing,” or “cheese,” milk did not need to meet the same standards. This was not the feeling at Tillamook, where the same level of quality was expected for cheese as for fluid milk. Some other cheese manufacturers in the Northwest failed to recognize that top-quality milk was essential for the production of top-quality cheeses. These companies are no longer a force in the marketplace.

In the 1980s, Tillamook’s board implemented an aggressive incentive plan that provided a premium to dairy farmers who attained a higher level of quality. At that time, the company average for somatic cell count (SCC) in milk was 400,000 per milliliter. Bonuses of up to 25 cents per hundred pounds of milk were offered to dairy farmers who would reduce their SCC count to less than 100,000. Few farmers felt that such a low number was attainable. Yet, within months, test results indicated a significant improvement in herd health, with company average results dropping below 200,000 and as many as 50 of the Tillamook County Creamery Association’s dairy farmers attaining the less than 100,000 goal.
Today, the quality heritage is a major part of Tillamook's message. We are unique in the close contact our field staff has with the dairy farmers. Nearly all of the dairies are located within a 30-mile radius of the plant, with two-thirds of them less than 10 miles away.

This allows daily contact with any dairy farmer who experiences quality problems, and it allows the milk to be transported quickly to the plant for daily processing. Our facility, which operates 365 days a year, processes virtually all milk the same day it is produced.

With the emphasis on quality have come some pleasant benefits. Tillamook products do not use any preservatives for extending shelf life. Vacuum packaging, or the lack of oxygen, is the only mold inhibitor used in storage of cheese. Heat treating of the milk, but not pasteurizing it, allows many beneficial enzymes to remain in the cheese, imparting the special Tillamook flavor and body.

All Tillamook cheese is aged over 60 days before final preparation for sale. Quality assurance tests at this point, and lactic acid development, gives double protection from postpasteurization contamination, which has been the source of illnesses in some cheeses that are manufactured and sold without proper aging.

Lush green pastures, pristine streams, a moderate climate, and isolation from urban pollution all contribute to the Tillamook mystique. Furthermore, with the 1949 opening of the large plant on Highway 101, north of Tillamook, visitors began asking if they could view the cheesemaking process. At first, groups were ushered through the plant, but as numbers swelled, sanitation and safety became more of a concern, and a viewing area was constructed.

Since 1968, interest in this area has grown steadily. Now more than 800,000 visitors a year stop by to view production, browse in the gift ship, or indulge themselves with one of more than 650,000 ice cream cones served up each year. This volume of visitors rates as the third highest in Oregon, according to the Oregon Department of Transportation.

As potential customers view the actual production and packaging of Tillamook cheese, the messages of quality and care are reinforced. An example of the effectiveness of these messages is the public acceptance of Tillamook ice cream throughout the Northwest. As more and more visitors sampled Tillamook ice cream at the plant, they asked why it was not available in the grocery stores back home. Even though we had produced it since 1949, ice cream was sold only locally until three years ago when we embarked on a distribution plan for Tillamook ice cream that has already placed 6 of the top 10 selling flavors of premium ice creams in Oregon, according to Info Scan, a market sales reporting service. The message is clear: quality is a product that cannot be oversold.
Consumer concern over seafood safety has made quality assurance programs a fact of life for the seafood industry. Gone are the days when simply having a quality assurance program sharpened your product's competitive edge. Today, quality assurance programs are a necessary part of doing business. The distinguishing factor is how you market your quality assurance program, how you let consumers, the trade, and business partners know how your program assures them of a safe, high-quality product. Creative, strategic marketing of your quality assurance program can greatly influence the perception of your product and its perceived value.

To illustrate the state of the art in innovative marketing of quality assurance programs, I present case studies of three marketing associations: the Association of Chilean Salmon Farmers, the Maine Department of Marine Resources, and the Alaska Seafood Marketing Institute. These, along with others, are organizations that are breaking new ground in making the most of their quality assurance programs.

ASSOCIATION OF CHILEAN SALMON FARMERS-QUALITY ASSURANCE IN TODAY'S COMPETITIVE MARKETPLACE

When the Association of Chilean Salmon Farmers formed in 1986, it faced a very competitive marketplace. The world knew little about Chile in general and even less about its fledgling salmon farming industry. Given the high quality of product produced in Europe, primarily by the market leader, Norway, the Chileans realized that a successful entry into the world market depended on guaranteeing this high quality themselves.

With this in mind, the association set out to ensure that all salmon raised by its members was harvested, processed, packed, and shipped at the highest level of quality. The association adopted a code of quality standards and an independent inspection process that rank among the most rigorous in the world. This quality assurance program has been marketed aggressively, becoming a "competitive edge" for Chilean salmon and contributing to the rapid rise in global demand for the Chilean product. Japanese seafood buyers, who are among the world's most selective, purchased over 28,000 metric tons of Chilean salmon in 1992.

Brief Outline of the Association's Quality Assurance Program

The association's quality assurance program is based on a set of rigorous guidelines for plant construction and sanitation, worker hygiene, equipment specifications and sanitation, and processing standards. The program also includes specific product characteristics for each species of salmon produced in Chile, along with descriptions of the characteristics for each grade of product. To give the program real teeth, the association requires that quality control inspectors from independent certifying agencies supervise all inspections.

The process begins at the point of harvest, where inspectors check the salmon for size, shape, appearance, and overall health according to the code's criteria. Inspectors are also present during processing, making sure the fish are headed, gutted, and cleaned under exceedingly sanitary conditions. After processing, inspectors grade the fish, rejecting those salmon not meeting the association's standards. Fish that pass inspection are iced and packed for export with the Association of Chilean Salmon Farmers' seal. This seal, the centerpiece of the association's program, is given only to fish that have been processed in a certified plant by an independent inspector and have been classified as Premium or Grade 1 quality.

The fish are also inspected once they reach the Santiago airport, before being flown fresh to world markets. At this checkpoint, product temperature and the condition of the ice and packaging come under the inspector's scrutiny. These final inspectors also pay close attention to elapsed processing time - the time that
has passed from leaving the water to shipment. Again, if the fish do not meet the approval of the inspectors, they are not shipped.

In 1992, the association expanded its inspection manual to include regulations for the technical requirements and sanitary conditions in each salmon processing plant. The manual now specifies plant code regulations for wall and floor coverings, processing tools, clothing, gloves, and masks. The association also developed individual quality standards for each species of fish raised in Chile.

Each year, the association organizes a symposium to review its quality standards. Improvements are made on the basis of past experience and new techniques.

Marketing the Program

The association has made its quality assurance program one of the cornerstones of its strategic positioning. All elements of its marketing program reinforce the quality assurance message to educate buyers, consumers, and the trade.

The quality seal itself serves as the primary marketing tool. The seal is a visual reminder of the quality assurance program and a guarantee that the product has met its high standards. As well as appearing on inspected product, the seal has been used as a graphic element in trade advertising. Trade advertising copy always incorporates the quality assurance message. Here is a quote from the association’s current trade ad:

In this land of unspoiled beauty, each and every salmon is hand-raised, painstakingly tended, and processed according to the most exacting standards in the world.

There’s a difference, too, in the way Chilean salmon is packed and shipped, so it arrives at its destination as fresh as the moment it left the water.

Public relations is another way the association gets the word out about its quality assurance program. The association’s press kit includes a two-page release that outlines the inspection program in detail. And all other press materials incorporate the quality assurance message.

The association’s quarterly newsletter, The Chilean Salmon Farmer’s Almanac, also strategically markets the program to importers and buyers from retail and restaurant chains. Each issue includes an article on the quality or the safety of the product. Recent headlines include, “Chilean Salmon: A Safe Choice” and “Chile Toughens Already Strict Inspection Standards.”

One of the association’s most successful marketing efforts was the January 1992 Food Editor’s Tour of Chile. The tour aimed to educate consumers and the trade about the quality assurance program by showing them firsthand how it works. Food editors from a dozen national consumer broadcast and print media, including Better Homes and Gardens, Woman’s Day, Good Housekeeping, McCall’s, House Beautiful, and Ladies Home Journal, participated in the tour. The editors travelled to the salmon-growing region in the south of Chile to visit salmon farms and processing plants. The tour resulted in numerous articles and broadcast coverage, all stressing the association’s quality assurance messages. The tour won a 1992 Seafood Business Marketing Excellence Certificate of Merit.

By strategically marketing its quality control system, the association has successfully built the reputation of its product in key markets, allowing it to develop from a relatively unknown producer of farmed salmon in 1986 to the second largest producer of farmed salmon in the world today.

MAINE DEPARTMENT OF MARINE RESOURCES: MAINE FRESH GROUNDFISH QUALITY CONTROL PROGRAM--START SMALL AND GROW

The Maine Department of Marine Resources’ Maine Fresh Groundfish Quality Control Program developed 10 years ago out of a pilot program which had as its goal to develop a “Maine identity” for groundfish while responding to consumer quality and health concerns. At the time, the state had little in-state processing; instead, whole fish were shipped to the Boston area where they were sold as “Boston” or “New England” fish.

The department established a set of Standards based on the federal grade A program, which provides for a consistent level of quality and extends the shelf life of the product. Fish meeting the criteria received the “Maine Certified” logo. As with the Chileans, the Maine logo became the cornerstone of all marketing efforts. According to a Department of Marine Resources representative, studies have shown a strong link between the perception of quality and a seal or stamp. The Maine logo not only
provides this association with quality, but backs it up. They have built their program by implementing tough standards, working closely with the state’s processors to enlist industry cooperation, and then creatively marketing these standards nationwide.

"In the Beginning" — Creative marketing to the Supermarket Industry

Maine adopted a marketing program that was more narrowly focused than that of the Chilean salmon farmers. To introduce their new logo, the department developed a Pilot project targeted to supermarkets. Two processors and two chain supermarkets, Shop and Save and Shaw’s, agreed to participate. The supermarkets each sold the Maine label in six stores in the Portland, Maine, market. The department developed recipe brochures to display near the product in the stores. Clip-on tabs with the logo were also attached to the price tags in the display case so that consumers could immediately identify the Maine certification. The initial pilot program was intended to run for six months, but after only 14 weeks it had become so successful that both chains extended it into all of their stores.

Based on the success of the pilot program, the department set up a full-blown supermarket campaign, putting their own representatives in the stores to help supermarket personnel improve sanitation and increase product shelf life. The department helped write individual company manuals, developed on-site training programs, and conducted free seminars if a store agreed to purchase the Maine product exclusively.

As the Maine product made its way into metro New York supermarkets, the department found their in-person training efforts strained because of the high turnover of supermarket employees. This inspired the department to create a video retail training program consisting of four videos: identifying quality product; setting up and sanitizing a cooler; sanitizing, icing, and setting up a full-service case; and merchandising product. Since its development, many companies have purchased this program. Through its videos and training programs, the Maine department quickly established itself as the expert in quality assurance at the supermarket level.

The industry has recognized Maine’s achievements. The Maine program was given a top prize in the Seafood Business Marketing Excellence Awards.

ALASKA SEAFOOD MARKETING INSTITUTE—MARKETING INSIDE OUT

The Alaska Seafood Marketing Institute’s (ASMI) quality control marketing program differs from my first two case studies in that it focuses on internal marketing — educating those involved in the harvesting and processing of Alaska seafood.

ASMI has developed species-specific handling guidelines for fishermen, tender operators, processors, cold storage facilities, and distributors, with the major emphasis on fishermen and processors. These recommendations are “sold” through videos, workshops, brochures, trade shows, and conferences.

Having enrolled the cooperation of fishermen in quality assurance, ASMI back sells their participation and expertise to seafood buyers. As an example, here is a line from a recent ad for Alaska Halibut: “And the quality is ensured by the experience and expertise of the Alaskan fishermen who catch it.”

Currently, ASMI also has an advertising campaign in Seafood Leader that aims to educate retailers about quality assurance for the Alaska product. The campaign advertises a series of training videos for retail employees that focus on maintaining seafood quality in a retail environment.

TEN TIPS FOR MARKETING YOUR QUALITY ASSURANCE PROGRAM

The Association of Chilean Salmon Farmers, the Maine Department of Marine Resources, and the Alaska Seafood Marketing Institute each offer examples of creative strategies for marketing a quality assurance program. Clearly though, each group has a different target market and different marketing objectives and therefore employs unique tactics. Some of these you might have found potentially applicable to your group — others not.

I would like to close by giving some tips that are generally applicable, what I call my “Ten Tips for Making the Most of Quality Assurance Marketing.”

1. Quality assurance is no longer the exception. It’s the rule.

Given the seafood safety issue, especially in the United States, a good quality assurance program is a necessary part of doing business in the seafood industry today.
2. **You can't market what you don't have.**
   Make sure that your quality assurance program is in place and running well before marketing it. False starts make your marketing job much more difficult.

3. **Make sure your team knows the score.**
   Develop and clearly articulate your position on customer safety and product quality. Then, make sure everyone in your organization knows about it and subscribes to it.

4. **Get a handle on handling complaints.**
   Marketing your quality assurance program will heighten the expectations of your customers. Be sure you have a response mechanism in place to handle any complaints that come up quickly and effectively.

5. **Start small and grow.**
   If you have a limited marketing budget, use it to do a few things well. Then expand your program from there.

6. **Don’t forget your customer’s customer.**
   For real impact, market your program up and down the distribution chain. If your buyer’s customer believes in your quality assurance program, then that’s added value.

7. **Quality assurance doesn’t stop with you.**
   Your quality assurance job doesn’t end when the product leaves your door. Follow-up to make sure your product is well handled by those who transport and handle it. And build into your marketing plan the time and budget to educate your customer about how to maintain the quality of your product.

8. **Make your package count.**
   By placing your quality assurance message directly on the package, you are saying something about what’s inside. Don’t forget to repeat your quality assurance message in all of your marketing communications.

9. **Beware of the words “high quality.”**
   Everyone uses the words “high quality” and soon everyone will be touting their latest quality assurance program. You must find ways to communicate how your program is different.

10. **Tell the world your story.**
    Work with the trade and consumer media to get the word out about your quality assurance program. These “third-party” endorsements are invaluable in establishing a favorable reputation for your product.