

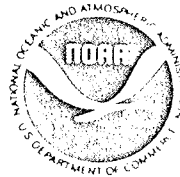
FINAL REPORT

PROJECT TITLE: "Development and Implementation of a Computer Education Program for Fishermen and Seafood Processing and Marketing Firms"

PRINCIPAL INVESTIGATOR: Judy L. Jamison  
Gulf & South Atlantic Fisheries Development Foundation, Inc.

GULF & SOUTH ATLANTIC FISHERIES DEVELOPMENT FOUNDATION, INC.  
COOPERATIVE AGREEMENT NO. NA90AA-H-SK040  
CONTRACT NO. 40-16-29066/22148 and 40-17-24884/26318  
AWARD PERIOD 02/01/88 THROUGH 04/30/92

Gulf & South Atlantic  
Fisheries  
Development  
Foundation, Inc.



\* A report by the Gulf & South Atlantic Fisheries Development Foundation, Inc. to the National Oceanic and Atmospheric Administration pursuant to NOAA Award No. NA90AA-H-SK040.

FINAL REPORT

Grant No. NA90AA-H-SK040

Foundation Contract No. 40-16-29066/22148  
40-17-24884/26318

Amount of Grant: Federal \$64,676 Match \$48,466 Total \$113,142

Project Title: "Development and Implementation of a Computer Education Program for Fishermen and Seafood Processing and Marketing Firms"

Grantee: Gulf & South Atlantic Fisheries Development Foundation, Inc.

Subcontractor: Louisiana State University and Virginia Polytechnic Institute and State University

Award Period: From 08/01/90 To 04/30/92 (as amended)

Budget Period: From 08/01/90 To 04/30/92 (as amended)

Period Covered by this Report: From 08/01/90 To 04/30/92

Under this Award, two contracts were initiated; #40-16-29066/22148 with the Louisiana State University and #40-17-24884/26318 with Virginia Polytechnic Institute & State University. The original Cooperative Agreement dates were August 1, 1990 through July 31, 1991. Three Amendments were executed during the course of this Award. Amendment #1, executed on October 10, 1990, revised the requirements of certain Special Award Conditions due to the anticipated hiring of a new Executive Director. Amendment #2, executed on April 22, 1991, provided a no-cost extension through January 31, 1992, revised Special Award Condition #5 to correct funding, and added new NOAA Special Award Condition #18. Amendment #3, executed on March 5, 1992, provided a three month no-cost extension through April 30, 1992.

Final financial information on this Award has been forwarded to the NOAA Grants Officer.

I. EXECUTIVE SUMMARY

The original objective of this project was to develop and implement an educational program to increase the computer awareness, knowledge, and skills of individuals obtaining a livelihood from the sale of marine food sources. The goal of the project was to assist fishermen and seafood dealers to implement computer technology for business, management, and production analysis. This goal was amended to expand upon computer training among those firms already using computers. In addition, since HACCP was recognized by the National Academy of Sciences as the method of choice in

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implementing mandatory seafood inspection programs, additional emphasis was placed on employing computer technology with HACCP to demonstrate the feasibility of using computers in seafood processing quality control.

This project was conducted with overall coordination from the Gulf & South Atlantic Fisheries Development Foundation, through subcontracts with Louisiana State University and Virginia Polytechnic Institute and State University, with Sandy Bridgman of the Virginia Seafood Council acting in an advisory capacity. Through this arrangement, the benefits of the project were rapidly disseminated to the entire seafood harvesting and processing industries along both the South Atlantic and Gulf coasts. The principle investigators developed computer programs for on-board and in-plant business management, and programs for quality control analysis for several types of seafood processing operations. In addition, computer labs were set up, and workshops benefitting seafood harvesters and processors were given on both the Gulf and South Atlantic coasts. The project provided excellent encouragement for the seafood industry to use or expand upon computer technology for business management and quality control, and aided in preparing the industry for probable mandatory seafood inspection using HACCP in the near future.

## II. INTRODUCTION

Along with the growing use of computers in all aspects of business, it has become essential over the last number of years that computers come into general use in the seafood industry. Within the seafood industry, computers are and can be used for business record keeping, inventory control, and computer monitoring of quality control in processing. Concurrent with the increasing use of computer technology in business has been increased concern about the quality of food products, and, in particular, the quality of seafood. This resulted in recommendations from the National Academy of Sciences that the HACCP, or Hazard Analysis Critical Control Point, concept be used as a basis for seafood inspection programs. Since quality assurance, such as that provided through HACCP, is ideally amenable to computer monitoring, it has become evident that computer technology will aid seafood processors in complying with future mandatory seafood inspection regulations.

An initial Foundation computer education project provided financial support to initiate a comprehensive computer education program, and within 2 years most major seafood processors had purchased computers and were using them for a variety of technical application and business management tasks. With rapidly changing market and business conditions, combined with the high likelihood

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of mandatory seafood inspection and stringent quality control in the near future, traditional record keeping and quality control methods are no longer adequate. Computer technology offers an economical and accurate method of monitoring seafood processing, as well as providing support in business record keeping. Many aspects of processing can be monitored effectively by computer, including storage temperature and pasteurization temperature. In order for seafood processors to use computers, equipment must be economical, simple to use, and reliably accomplish the tasks to which it is assigned. The purpose of this project was to provide computer technology for business and processing applications in a comprehensive, cost effective manner, and to effectively disseminate information on computer applications for business and quality control to both the seafood processing and harvesting sectors.

### III. PURPOSE

Although computer technology has reached the level where extremely powerful computer applications to the commercial fishing industry are available at reasonable prices, few companies use the technology except for record keeping and inventory control. With mandatory seafood inspection employing HACCP so close on the horizon, it will be necessary for seafood processors to improve their monitoring of seafood processing, and this may best be done using computer technology. Unfortunately, most seafood companies do not have computer literate personnel on their staffs, are not aware of the potential benefits of the cost effective computer technology that is currently available, and do not have continuing support from software experts once systems are installed. Consequently, it is unrealistic to expect seafood producers to readily adopt the use of computers without an appropriate educational program.

The objective of this project was to assist fishermen, seafood dealers, and processors in implementing computer technology for business, management, and production analysis. Specifically, the project was intended to design and implement a program that would demonstrate the various applications of computer use in the seafood industry and how they could ultimately affect firm profitability and ability to comply with seafood inspection regulations.

### IV. APPROACH

The Foundation subcontracted with two universities, Louisiana State University (LSU), and Virginia Polytechnic Institute and State University (VPISU) to carry out this project. For LSU, the primary

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focus was on computer education programs. To be most effective, these education programs were conducted in regional areas of Louisiana and at a computer lab at LSU. The LSU project was divided into five phases, as listed below:

1. Five educational workshops were scheduled throughout Louisiana; designed in such a manner as to maximize participation. This was done with help from Louisiana marine extension agents. This training stressed two major topics: HACCP and computer technology. Those attending were taught the basics of computer technology, and were familiarized with the necessary computer hardware. Demonstrations of pasteurization and other computerized processing monitoring were employed.
2. Phase two developed, upgraded, and used computer templates for the crab, alligator, shrimp and pasteurization industry. In this phase, a previously developed crab processing template was made available to the seafood industry. In addition, an alligator financial analysis program was made available, and a shrimp processing template was developed. The shrimp processing template was developed at the request of shrimp processors who attended the phase one workshops. Finally, the crabmeat pasteurization F-value program was programmed onto the WorkBench software.
3. In phase three, a computer work station was established at Knapp Hall at LSU for seafood processors and others to receive hands on training and to have access to a computer library. In this phase, structured computer training was provided to seafood industry participants using the principle investigator and his assistants as instructors.
4. In phase four, a computer technician was employed for assistance with the implementation of computer training workshops, and for the development of templates.
5. In phase five, Marine Advisory agents from the Louisiana Cooperative Extension Service and the Louisiana Sea Grant Program were trained in the basic application of HACCP, and the use of computers in seafood processing plants.

The objective of the VPISU project was to provide an educational program on the applications of computers in business and processing technology to seafood producers and processors. The method to achieve this goal was to develop computer programs that addressed specific needs. These programs were presented at the individual, state, and national level. Audiences identified for inclusion in the program were fishermen, seafood processors, and aquaculture

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managers. The researchers also realized that some of the developed computer applications may be useful to state and federal agencies having regulatory responsibility over seafood products.

Overall project management was undertaken by the Gulf & South Atlantic Fisheries Development Foundation, Inc., with subcontracts being awarded to Louisiana State University and Virginia Polytechnic Institute and State University.

## V. FINDINGS

The results of the five phases of the LSU subcontract are listed as follows (additional details are provided in the contractor's final report, attachment A):

1. Five educational workshops were held throughout Louisiana. These workshops were conveniently located and otherwise designed to maximize participation. Louisiana marine extension agents helped in this effort. The workshops were held in Houma, New Orleans, Hackberry, Baton Rouge, and Lafayette, with 25 people each attending the Houma and New Orleans workshops, approximately 16 attending each of the Baton Rouge and Lafayette workshops, and only 3 attending the Hackberry workshop. Training centered on HACCP and computer technology, and those attending were taught the basics of using computers, and were familiarized with necessary hardware and software. The investigators used demonstrations of crab meat pasteurization at the workshops.
2. The investigators developed, upgraded and used computer templates for the crab, alligator, shrimp, and pasteurization industries. A previously developed crab processing template was made available, as well as an alligator financial analysis program. This latter program was designed primarily for investment and sales analysis. In addition, as a result of requests from shrimp processors who attended the phase 1 workshops, a shrimp processing template was developed. This was designed as an inventory and accounting program for controlling inventory at multiple locations, and provides a summary and daily production report. This program is currently in use by the Louisiana shrimp processing industry. Finally, a crabmeat pasteurization F-value program was programmed onto the WorkBench software.
3. A computer work station was established at Knapp Hall at LSU for seafood processors and others to receive hands on training and to have access to a computer library. Structured computer training was provided to seafood industry participants on

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January 21-22, 1992. Ten individual computer stations were set up, each with PC software and manuals. The principle investigators and assistants served as instructors, and each day had a full compliment of participants.

4. This phase employed a computer technician for assistance with implementation of computer training workshops and for the development of templates. The assistant was of great service in equipment assembly and programming for use by the seafood industry.
5. Marine Advisory agents of the Louisiana Cooperative Extension Service and the Louisiana Sea Grant Program were trained in the basic applications of HACCP and the use of computers in seafood processing plants. The agents received training through mailouts, hands-on training, and during computer training programs and area workshops.

The VPISU project set up a pilot demonstration of an on-board computer system with an appropriate business program installed to accommodate all financial records related to crew settlement. A second program was also provided that allowed for documentation of fishing gear hangs. This was done using a cooperating captain with a degree in business administration. The project principle investigators anticipate that the program showing gear hangs will provide substantial economic return since gear losses or damage is expensive.

Several programs were developed for fish and shellfish processors. Most of these programs related to the use of computers in developing and maintaining quality control and assurance programs. Assistance was also provided on the more basic uses of computer technology. The contractor's final report (attachment B) provides a list with detailed explanation of the programs that were initiated and presented during the grant period.

Two one-day workshops were given in Fredericksburg, Virginia and Annapolis, Maryland on financial planning and analysis for aquaculture enterprises. A third workshop was given at the East Coast Fishermen's Trade Show in Ocean City, Maryland. These workshops worked in a similar manner to those presented in Louisiana, in that they provided basic computer education, while providing specific benefits in the field of interest to those attending. Therefore, the workshops demonstrated financial marketing and production planning, as well as all aspects of financial matters related to the profitability of aquaculture firms. In addition, a seminar, designed to illustrate the impact of debt on firm profitability, was presented on financial resources for spreadsheets. This program focussed on bivalve culture in the

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Mid-Atlantic, and also served as a basic computer training effort to explain the use of spreadsheets and demonstrate the various programs that are commercially available. Detailed descriptions of activities related to the VPISU project are provided in the contractor's final report (attachment B).

No significant problems were encountered during the course of these projects that resulted in less than satisfactory results.

## VI. EVALUATION

### A. Project Goals

The goal of the project was to assist fishermen and seafood dealers to implement computer technology for business, management, and production analysis. The original contract with LSU was amended to reflect the current needs of the seafood industry by providing means of incorporating HACCP. The VPISU project was amended to include fishing operations and present a more rigorous program over that which was previously planned. Also, changes in state and federal policy concerning the various components of the seafood industry provided an opportunity to present computer training programs and concepts that could have direct and immediate use. Finally, during the unanticipated two-year delay in project start-up, most firms purchased computers for their business operations, and were thus more advanced than the original program anticipated they would be.

The project goals and objectives were quantifiable in terms of participation of seafood processors, fishermen, and Sea Grant extension agents at workshops and other project functions. Both the LSU and VPISU projects experienced good participation at workshops and other functions, as described in both contractor's final reports (attachments A and B). Also, with anticipated implementation of increasingly stringent quality control regulations, it will be necessary for the seafood harvesting and processing industry to become increasingly adept at monitoring processing operations. Since these projects clearly demonstrated the benefits of using computers in process monitoring applications, as well as provided several computer programs for this use, it is anticipated that the project results will be used in one manner or another by virtually the entire southeastern processing industry.

As mentioned above, an unanticipated two-year delay in project start-up precipitated the need for amendments to the original project goals. These amendments reflected the fact that computers had come into much wider use in the seafood processing industry for business and management related functions. This provided the opportunity to give computer training to those who realized its

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need, and to expand computer training among those already using computers for business management to quality control and other processing monitoring functions. Based on original and amended contractual agreements between the Foundation and LSU and VPISU, all project goals and objectives were accomplished. In addition, overall project goals and objectives were met, as amended.

B. Specific Accomplishments

The following describes the specific accomplishments of the five phases of the LSU project. Additional details on project accomplishments may be found in the contractor's final report (attachment A).

1. In phase 1, each workshop was held, as scheduled, and was coordinated through local sea grant extension agents. Participants at the workshops were enthusiastic and complimentary. Average attendance was 18 participants per workshop. One beneficial result of the workshops was that the investigators visited several processing plants to demonstrate computer systems for monitoring temperature controls and data acquisition
2. As described in detail in the contractor's final report (attachment A), several computer templates were developed. Most notably, a daily production report shrimp template was developed as a result of request from shrimp processors who attended the workshops.
3. The computer lab at LSU was made available for training on January 22, 1992. Ten work stations, each equipped with a computer and software, were made available for participants, and the principle investigator and assistants served as instructors. Participation was excellent for the workshops, and all stations were occupied for the full eight hours during the two workshops.
4. A graduate assistant was employed to provide training and to provide technical assistance in setting up and programming equipment. This proved to be an important part of the program.
5. Louisiana Marine Advisory Agents were provided with computer training, specifically centering on the HACCP concept. The project principle investigators believe that as a result of this training, Marine Advisory Agents will play a key role in the educational phase of implementation for HACCP based seafood inspection programs.

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The accomplishments of the VPISU project are as follows (additional details on project accomplishments may be found in the contractor's final report, attachment B):

1. The investigators wrote a comprehensive review of processing plant sanitation that was incorporated into a manual entitled "Seafood Industry Hazard Analysis Critical Control Point," which was published by the National Fisheries Institute. This review will be used by educators throughout the United States in presenting courses on quality control and assurance programs.
2. The concept of a computer database on product quality was discussed with NMFS. While NMFS does not currently permit the use of electronic databases in the inspection program, the agency did agree that the concept has future potential.
3. The blue crab sanitation program is being implemented in all Virginia crab processing plants, through a cooperative program involving VPISU, the Virginia Health Department, and the Virginia Division of General Services.
4. The computer program pilot aboard a commercial fishing vessel demonstrated that the use of on-board computers can significantly increase the efficiency of record keeping, and can be used to reduce the likelihood of expensive gear damage. Thus, computer technology can produce significant cost savings for commercial harvesters.
5. The clam and fish plant quality control programs, which were developed through this project, have been used successfully by several firms. The clam program is currently being re-written, and will be available in the near future.
6. The catfish plant quality control program developed through this project, will be used by Virginia Tech., Auburn University, and Mississippi State University in the identification and control of pathogenic microorganisms in catfish processing facilities.
7. The F value information presented at the pasteurization workshops given under this project, is currently being used by firms pasteurizing crab meat. This information is also being used in applying a thermal process that is lethal to Listeria monocytogenes. It is likely that this listeriocidal thermal process will be used increasingly as seafood quality programs come on-line. Eighty-seven seafood processors and federal and state health regulatory officials attended the two

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pasteurization workshops.

8. Under the aquaculture portion of this project, aquaculture firm managers were acquainted with how business decisions and debt affect the profitability of an enterprise. Over 120 individuals and government officials have been trained under this program to date.

The original project objective was to develop and implement an educational program to increase the computer awareness, knowledge, and skills of individuals obtaining a livelihood from the sale of marine food sources. The goal of the project was to assist fishermen and seafood dealers to implement computer technology for business, management, and production analysis. Due to delays in project funding, this goal was amended to expand upon computer training among those already using computers (computers came to be widely used for business record keeping purposes in the seafood industry during the two-year delay). In addition, during the two-year delay, HACCP was recognized by the National Academy of Sciences as the method of choice in implementing mandatory seafood inspection programs. As a result, emphasis was placed by both subcontractors on employing computer technology with HACCP to demonstrate the feasibility of using computers in seafood processing quality control.

Because it is expected that some form of mandatory seafood inspection will be implemented in the near future, having computer program available to meet new quality control demands will be of immense benefit to the seafood industry. Also, expanding on the traditional record-keeping use of computers for both seafood harvesters and processors demonstrated that substantial savings could be had with their proper use. Therefore, the individual computer programs developed in this project, in combination with the information made available through workshops, the sanitation chapter of the HACCP manual, and other training activities will continue to be highly valuable to members of the seafood industry and government regulators as mandatory seafood inspection comes on-line.

#### C. and D. Benefits to the Fishing Industry

The seafood harvesting and processing industry has complete access to the projects products and services through the dissemination capabilities of the Foundation, as well as through Sea Grant, LSU, and VPISU. In addition, the seafood industry is the major beneficiary of all computer programs generated through this project. These advanced computer concepts were readily accepted by the seafood industry, and the industry has requested additional training programs. Marine Advisory Agents used their network to

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advertise workshops and to offer assistance in working individually with seafood processors and harvesters, and many, if not all, of the computer programs developed through this project are already in use by seafood processors and harvesters. Therefore, the products and services supplied through this project have been, and will continue to be, extensively used by both the seafood harvesting and processing industry throughout the Gulf and South Atlantic coasts, as well as by state and federal agencies. In addition, because of the likelihood of mandatory seafood inspection being implemented in the near future, it is highly likely that quality assurance programs developed through this project will be used into the future. Finally, it is virtually certain that the programs and information supplied by this project will be used as a basis for modifications made necessary by regulation and changing needs of the seafood harvesting and processing sectors in the future.

Economic benefits are directly demonstrable through this project by cost savings demonstrated by the on-board computer system, and by cost savings realized by processing firms using quality assurance programs developed in the project. We anticipate future cost savings through the availability of quality assurance programs developed in this project as mandatory seafood inspection and HACCP programs are implemented. These cost savings should accrue over the next two to three years.

Based on the information supplied above, the primary benefits of this project are two-fold. First, the computer programs made as a result of this project combined with the information on HACCP and other key areas supplied at workshops, gives the seafood industry options for adapting to anticipated mandatory seafood inspection regulations as they are implemented over the next 2-3 years. Second, the computer programs and support facilities developed through this project will provide continuing cost savings to seafood harvesters and processors into the future. As a result, the benefits of this project are certainly continuing and direct, and are measurable in terms of maintaining profitability, or increasing profitability, through expanding the use of computers in business and quality assurance applications. None of the benefits resulting from this project resulted from negative findings.

#### E. Need for Federal Assistance

Because of the high likelihood of mandatory seafood inspection programs being implemented in the near future, it was necessary to develop and disseminate methods of adapting to future regulations while minimizing increased costs to seafood harvesting and processing firms. Since most seafood harvesting and processing firms are small and have limited financial resources available to them, it was necessary to procure federal assistance to provide

these firms ways of adapting to federal regulations in a cost effective manner. This project demonstrated that the use of computers in quality assurance and business administration provides such a cost effective method of adapting to a rapidly changing regulatory and economic environment.

## VII. CONCLUSION

As a direct result of this project, seafood producers and processors have an improved appreciation of the applications of computer technology in their business and processing operations. They were enabled to obtain hands-on experience with computer hardware and software with cost reducing and quality assurance applications for both the seafood harvesting and processing sectors. Computer technology can provide means of obtaining better control over business operations, and can serve an important role in controlling quality in accepted critical control points in processing. Processors now have a better understanding of the HACCP concept, and are thus better prepared to meet the requirements of anticipated federally mandated seafood inspection programs. The use of computer laboratories demonstrated to representatives from the seafood industry the benefits of hands-on training for many computer software packages. Also, the project provided important training to Marine Advisory Service agents on computer technology and the HACCP concept. Finally, this project stimulated the seafood industry to obtain additional information on computer technology that is useful in business and quality assurance applications. This project was very successful in reaching its objective, and was extremely well received by the fishing industry, and representatives from Sea Grant, state, and federal agencies. Finally, this project clearly demonstrated the need for further work in developing computer programs for business and quality assurance applications in all sectors of the seafood industry. It also demonstrated the effectiveness of information transfer efforts in this critical area. These information transfer efforts on the use of computer technology should also be continued.

Judy Z Jamison  
Signature of Principal Investigator

10/30/92  
Date

Judy Z Jamison for Peter Horn  
Signature of Project Director

10/30/92  
Date

FINAL REPORT

PROJECT TITLE: "Development and Implementation of a Computer Education Program for Fishermen and Seafood Processing and Marketing Firms"

PRINCIPAL INVESTIGATOR: George J. Flick  
Virginia Polytechnic Institute and State University

GULF & SOUTH ATLANTIC FISHERIES DEVELOPMENT FOUNDATION, INC.  
COOPERATIVE AGREEMENT NO. NA90AA-H-SK040  
CONTRACT NO. 40-17-24884/26318  
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\* A report by the Gulf & South Atlantic Fisheries Development Foundation, Inc. to the National Oceanic and Atmospheric Administration pursuant to NOAA Award No. NA90AA-H-SK040. The views expressed herein are those of the author and do not necessarily reflect the views of NOAA or any of its sub-agencies.

**FINAL REPORT**

**PROJECT TITLE:** Development and Implementation of a  
Computer Education Program for  
Fishermen and Seafood Processing and

**GRANT NUMBER:** Cooperative Agreement  
No. NA90-AA-H-SK040  
  
GASAFDFI Contract  
No. 40-17-24884/26318

**AMOUNT OF GRANT:**

Federal	\$24,884
Match	\$24,985
Total	<u>\$49,869</u>

**GRANTEE:** Virginia Polytechnic Institute  
and State University  
Food Science and Technology Department  
Virginia Sea Grant

**PRINCIPAL INVESTIGATORS:** George J. Flick and Geoffrey Knobl

## II. INTRODUCTION

Computer technology has become an integral part of the successful operation of many business firms. Seafood producers and processors have been no exception. A previous grant from the Gulf and South Atlantic Fisheries Development Foundation, Inc. provided financial support to initiate a comprehensive computer education program. This project included both basic and applied computer programs. Initial classes informed participants on the selection and purchase of appropriate hardware and software. Advanced classes discussed the use of computers in business and managerial accounting, word processing, payroll, inventory control, and accounts management. Within two years after the program was terminated, most of the major seafood processors had purchased computers and were using them for a variety of technical applications and business management programs.

The new project provided an opportunity to expand the prior program to seafood producers (fishermen) and include advanced business and processing applications. Processing applications are becoming an important use for computer technology and include the process control and monitoring and quality assurance. Quality assurance has achieved greater significance due to the National Academy of Sciences (NAS) recommendation that any mandatory seafood inspection program be based on the HACCP (Hazard Analysis Critical Control Points) concept. Additionally, the Virginia Tech Sea Grant program began to develop additional computer based training programs and expand the audience to include the rapidly growing aquaculture industry.

## III. PURPOSE

The use of computers in business and technology has developed for several reasons. Management needs to have greater control over their business practices if they are to remain financially solvent and have their decisions based on fact, rather than speculation. The purpose of this project was to design and implement a program that would demonstrate the various applications of computer use in the seafood industry and how they could ultimately affect firm profitability. It is unrealistic to expect seafood producers and processors to readily adopt the use of computers without an appropriate educational program. This is true for several reasons: most seafood related firms do not have computer literate personnel employed on their staff; most of the software applications need to be demonstrated since vendors are not knowledgeable about seafood operations and what programs are most applicable; and once seafood firms purchase computers and supporting software, they will need continuing

support to maintain the programs and increase the application scope.

Computer technology will enable most seafood firms to have better control over quality aspects since relational databases can be established which cover all components (as microbiological, compositional, chemical, and sanitation) of a HACCP based quality assurance program. Recent activities within the U. S. Food and Drug Administration (FDA) have supported the importance of improved seafood and seafood product quality control. Within the last year, the FDA has established the Seafood Unit as an independent inspection branch. It is the only division in the FDA that is commodity specific. This branch is currently visiting all seafood processing operations and is enforcing a zero tolerance for the presence of Listeria monocytogenes in cooked or raw ready-to-eat fish and shellfish products. A computer based quality assurance program will permit the implementation of programs to more easily accommodate this directive.

#### IV. APPROACH AND FINDINGS

The objective of the project was to provide an educational program on the applications of computers in business and processing technology to seafood producers and processors. The method to achieve that goal was to develop computer programs that addressed an identified needs. Programs were presented on an individual, state, and national level as part of the program. However, it is important to state that the effort will continue and expand once the project has terminated.

The audiences for inclusion in the educational programs were identified as:

1. seafood producers (fishermen);
2. seafood processors; and
3. aquaculture managers.

It was also envisioned that some of the applications would have application to state and federal agencies having regulatory responsibility with seafood products.

##### 1. Seafood Producers

Seafood producers have not received the benefits of computer technology for several reasons. The major being that their ability to attend educational programs is curtailed due to their limited presence on shore. Also, some of the fishermen have small businesses and the management operations can be handled either by themselves or their spouses without computer technology. However, large off-shore fishing vessels

with crew members can readily use computers for financial and business management, fishing records, and vessel management, as maintenance. Of primary interest are business transactions involving payroll and product sales.

A cooperative off-shore fishing vessel captain having a degree in business administration was identified and agreed to participate in the project. A computer was installed on the vessel with appropriate software and a business program was written that would accommodate all financial records related to crew settlement. This included payroll related matters as well as savings and other investment programs. A second program was given to the vessel captain on the conversion of Loran readings so that fishing operations as monitored by navigational instrumentation could be interfaced with gear hangs. The captain entered the various hangs on the program and has established a small business venture on the sale of computer programs indicating the Loran readings of gear hangs. It is estimated that this program will have substantial economic return since gear losses or damage is expensive. This is particular true when scallop or ocean clam dredges are involved.

The vessel captain has included other software programs on the computer through his own initiative. His use of computers and estimation of their usefulness will be monitored through 1993. A popular news article and a technical report will be prepared for dissemination to other vessel owners. Personal assistance, in addition to training programs, will be offered through the Virginia Sea Grant and Cooperative Extension Service programs to interested vessel owners and operators.

The program with fishermen will be continued and expanded to include other vessel owners and computer applications in future years.

## 2. Seafood Processors and Aquaculture Firms

Several programs were initiated for fish and shellfish processors. These programs were designed to complement the program presented in the Part I portion of the project. Most of the programs related to the use of computers in developing and maintaining quality control or assurance programs. The area of food safety and waste management are two issues that will have major impact on the seafood industry. Effluent standards enacted by federal and state environmental agencies have resulted in the closure of several seafood processing firms. Also, food safety concerns expressed by consumer interest groups and actions by the FDA are having a major economic impact on the seafood industry. While these new programming areas were incorporated into the program,

assistance was also provided on the more basic uses of computer technology.

The following programs were initiated and presented during the grant period:

A. Sanitation Chapter

A chapter (Appendix I) on sanitation was prepared and included in the "seafood Industry Hazard Analysis Critical Control Point" manual published by the National Fisheries Institute, Inc. (NFI). This chapter was to serve as the reference for several programs related to plant sanitation and quality assurance and control prepared under this project. The chapter contained the basic information for developing a sanitation program and includes a model sanitation program using crawfish as an example. The NFI manual and accompanying slides are available to any group or agency wishing to develop HACCP training programs for the fish and shellfish industry.

B. Clam Processing Quality Control Program

This computer program (Appendix II) is basically a quality control manager that considers all aspects of sanitation. The program includes aspects as:

- I) food and non-food contact surface (microbiological);
- II) meat and juice product (both chemical and microbiological quality);
- III) well water (chemical and microbiological); and
- IV) waste (chemical and microbiological).

The program was designed to be both used by industry and serve as an educational model. One firm has included the program as part of their quality assurance program and has requested personal assistance for upgrades. A brief description of the program is given since this is one of the first times a computer based integrated quality assurance program for a seafood firm has been implemented.

There are 5 different spreadsheets that make up the database system: Microbiotic Well Sample, Micro Juice Sample, Micro Surface, Micro Meat and Waste Management. These spreadsheets are Quattro Pro files each containing several easy to use functions. The functions, called macros, contained in each spreadsheet can sort the information in the spreadsheet, find values over a given maximum, set a maximum value for many of the tests, print the spreadsheet, and graph on paper and on the monitor the values in the spreadsheet. Data can be transferred by using Quattro's capabilities to save a spreadsheet in a number of formats including dBase,

Lotus 1-2-3, Lotus Symphony, Paradox 7, Reflex, as well as the standard ASCII text file. All of these files may be transferred over the phone lines via modem or through a computer network. If properly installed on a file server, a user may gain remote access to the database.

Each of the different spreadsheets contain information on different tests. Below is a list of the contents of each spreadsheet.

Microbiotic Well Sample area contains Date, Time, Location, pH, Chloride.

Microbiotic Juice Sample contains Date, Time, Location, Lot Number, pH, Odor, Aerobic Plate Count (APC), Mold Count, Total Coliform, Fecal Coliform, E. coli Count, and positive tests for Salmonella, Coagulase Positive Staphylococcus, Vibrio vulnificus, and Listeria monocytogenes.

Microbiotic Surface Sample contains Date, Time, Location, Lot Number, pH, Appearance, Aerobic Plate Count (APC), Total Coliform, Fecal Coliform, and positive tests for Salmonella, Coagulase Positive Staphylococcus, Vibrio vulnificus, Listeria monocytogenes.

Microbiotic Meat Sample contains Date, Time, Location, Odor, Ammonia Content, Pesticide Presence and Concentration, Herbicide presence and concentration, Industrial Organic presence and concentrations, Selected Elemental Presence and Concentrations, and pH.

Waste Management includes Date, Time, Location, pH, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Soluble Solids (TSS), VSS, Temperature, Volatile (Acids), Alkalinity, Kjeldahl Nitrogen, Ammonia, Total Phosphorus, FOG, Methane, CO<sub>2</sub>, H<sub>2</sub>SO<sub>3</sub>, Oil/Grease, APC, Total Coliform count, Fecal Coliform count, and E. Coli count.

Originally, the database was developed in dBase IV. The decision was made to change the database from dBase IV to Quattro Pro to provide a more user friendly environment and to work with software to which the seafood processor already had access. There are a few differences between the two software packages. Quattro Pro is somewhat slower in sorting large amounts of data and may not be able to handle as much information as dBase IV. This will result in storing the database files every few months rather than every year.

However, Quattro Pro provides easily usable graphing capabilities. Now, with minimal effort on the user's part, a graph can be created, displayed, and printed directly from the processors entered data without using any outside programs or re-entering the information. Other differences include the ability to enter data into the spreadsheet while observing all other information in the same section and a visible method of identifying all values over a given maximum.

The chief concern during the programming of the spreadsheets was to provide the user with an easy to use method of sorting, searching, graphing, and printing the spreadsheet. To accomplish this, automatic macros were written utilizing Quattro Pro's ability to read an Alt-letter keystroke to run a macro. Thus, as many of the macros as possible are written so holding down the Alt key then pressing one of the letter keys will run them. Here is a list of the automatic macros available in the Microbiotic Surface Sample:

- Alt-A - Find high APC values
- Alt-B - set Maximum APC value
- Alt-C - Find high Total Coliform
- Alt-D - set Maximum Total Coli
- Alt-E - Find high Fecal Coliform
- Alt-F - set Maximum Fecal Coli
- Alt-G - Find high and low pH
- Alt-H - set Max and Min pH
- Alt-I - Sort on Location
- Alt-J - Sort on APC
- Alt-K - Sort on Total Coliform
- Alt-L - Sort on Fecal Coliform
- Alt-M - Sort on pH
- Alt-N - call main menu
- Alt-O - Fast Graph
- Alt-P - Print spreadsheet
- Alt-Q - Print Graph
- Alt-R - Sort on Date

After writing so many macros, it became evident another method of accessing the macros was needed. A menu system was developed so the user wouldn't have to memorize all the Alt-letter combinations. Of course, the user may still use the Alt-letter combinations if wished as they will avoid stepping through all the menus.

To use the commands described above press Alt-N. This reveals a menu with seven options: Find, Maximums, Sort, Graph, Print, Locations, and Quit.

---

Find  
Maximums  
Sort  
Graph  
Print  
Locations  
Quit

---

Select the options with either a mouse, the selection bar which moves using the arrow keys, or by typing the highlighted first letter of the option.

The first option, **Find**, reveals a list of all tests conducted whose values are continuous, all the counts and pH values for example. Selecting one of these options finds all values out of specification for that option and marks it with an asterisk '\*'. This changes the value from a number to a string which in turn causes it to stand out from the other values since strings in Quattro are left justified rather than right justified as numbers are. Again, to select an option, use either the scroll bar, mouse, or first letter of the option.

---

Standard Plate Count  
Total Coliform Count  
Fecal Coliform Count  
pH  
Quit

---

The second option, **Maximums**, allows you to set the maximums and minimum values for all continuous tests. For instance, the maximum value for Fecal Coliform is 2.3 per gram. This value is pre-set into the database but the user may change this value by selecting **Maximums** then **Fecal Coliform Count** and entering another value as a safety factor. Thus, the value could be entered as 2.0. Next time **Find Fecal Coliform** is chosen, all values over 2.0 will be marked.

Sort, the next option, lists the same options as Find and Maximum plus the Location and Date. Choosing any of the options sorts the database on that value in ascending order. One note of caution, this is the only function which directly moves all the information in the database. As such, in the unlikely event of a computer error during this operation data can be lost.

---

Location  
Date  
Standard Plate Count  
Total Coliform Count  
Fecal Coliform Count  
pH  
Quit

---

Graph brings up another menu listing all the options relating to graphs.

---

Fast Graph  
Location Graph  
Update  
Print  
Quit

---

Fast Graph creates a simple graph of all the continuous tests versus time. Two y-axes are used since the values for Aerobic Plate Count are much greater than those for other values such as pH or Fecal Coliform Count. The values are regardless of the location of the tests.

Location Graphs are the same as Fast Graphs except they contain only the information recorded from one test site. When the Location is chosen, another menu appears listing all the current test sites by number.

Choose the number representing the test site for which you want a graph and select it by using the bar selector or a mouse. Since the first characters are not unique, that is 1 and 11 begin with the same digit, a single keystroke of the highlighted digit will not always select the location you want. Therefore, do not use this method to select a location.

Update copies all the current data in the database to a different location for use by the graph macros. This ensures that the graphs you produce will contain all the current information from the database. If you do not Update and run either Fast Graph or a Location Graph the information will contain only the information at the time of the last Update.

Print produces the last graph you made on whatever printer you have connected to your computer. The Print option on the main Alt-N menu sends the current spreadsheet information out to the printer connected to the users computer.

To properly select a printer, see the Quattro manual, otherwise the computer may not print the graph or spreadsheet.

The Locations option lists all the current testing locations associated with a number. This produces no output and does not effect the database in any manner. It is simply there for reference so the user may enter the correct corresponding number into the database.

All menus with the exception of the Locations menu have a Quit option that will leave the menu system. Hitting the escape 'Esc' key while in the menu system will back the user up to the previous menu.

Of course, each spreadsheet's macros are dependent on the information the spreadsheet contains. So for Waste Management there will be a sort, find, and set max macro for Kjeldahl Nitrogen but not for Chloride which is in the Microbiotic Well Sample.

To start the spreadsheet, enter Quattro and retrieve one of the files representing the above five areas: MicWell.wq!, MicJuic.wq!, MicSurf.wq!, MicMeat.wq!, WastMan.wq!. The wq! extension is a compact form of storage for the spreadsheet. After the spreadsheet is open, go to (F5) cell AA51. This is the upper left corner of the database. If you have previously entered the spreadsheet and saved any changes, Quattro will automatically move you to your last position. From AA51, you can see the first of several columns of information. Each spreadsheet starts with the Lot Number, next the Date, Time, and Location. All other column orders depend on which spreadsheet you use.

### C. Blue Crab Sanitation Program

A blue crab sanitation program (Appendix III) was developed to assist blue crab processors improve the overall quality of their products and develop an effective sanitation program. This activity was most important since the FDA has initiated an aggressive inspection program to eliminate Listeria monocytogenes in cooked and raw ready-to-eat fish and shellfish products. The program will be presented to all 57 Virginia crab processors during July, 1992 under a supplemental grant provided by the Virginia General Assembly. Also, funds have been provided to the Virginia Health Department and Virginia Division of General Services to assist in the training effort.

The program is divided into three parts:

- I) product flow chart indicating control and critical control points;
- II) listing of the concerns at each control and critical control point; and
- III) a recommended cleaning and sanitation program at each control and critical control point.

The program is designed to be placed on a personal computer and can be interface with the internal clock. When interfaced, each working day a listing of the required cleaning and sanitation is produced. Also, cleaning and sanitation tasks that are not performed on a daily basis will be produced on the indicated date. This program can assist a processor develop improved cleaning and sanitation programs since infrequent tasks do not need to be committed to memory or a paper record system that can be easily lost or forgotten. Also, the computer based system can be easily modified to accommodate changes in cleaning schedules, physical plant modification, or unit processing modifications.

The information in this program was presented at an annual meeting of the NFI's National Blue Crab Industry Association. Industry representatives have requested a copy of the program when it is completely field tested and available for distribution. It is anticipated that the program will be available for the 1993 crab season.

### D. Fish Plant Sanitation and Quality Control Program

The fish plant sanitation and quality control program (Appendix IV) was designed for an integrated producer. It covers all phases of production (aquaculture) and processing. While the system was written for catfish, the model could be easily modified to accommodate any fin fish species. The program is similar to the previously described clam and crab

programs. The production considers the chemical and microbiological aspects of fish culture and quality assurance. This includes feed, growing water quality, and solid and liquid wastes. The program is able to have the data bases searched for specific or ranges of information. Also additions, deletions, and revisions to the various databases can be easily accomplished.

The sanitation portion of the program considers all phases of product quality. This includes environmental and product temperature, appropriate cleaning and sanitation procedures for food and non-food contact surfaces, and appropriate cleaning and sanitizing schedules for facilities and chemicals. The program is designed to be installed and run on a personal computer and the software interfaced with the computer's internal clock. As previously described, the various cleaning and sanitation schedules are produced on pre-determined time schedules. The program was developed in cooperation with Mr. Daniel Porter of DuBois Chemical Co., Inc, Cincinnati, Ohio.

The program was tested at two integrated fish production firms and was successful in controlling quality and improving the sanitary operations of their facilities.

#### E. Crawfish Plant Sanitation Program

A crawfish sanitation program (Appendix I) was prepared as part of the NFI's HACCP Training Manual. The program, however, can be used independently of the manual and will be distributed to processors in the future.

#### F. Crab Pasteurization Program

Two 1 day training programs on the use of computers in crab meat pasteurization were held in January, 1992. Attendees included crab processors and seafood inspectors in North Carolina, Maryland, and Virginia. The program included on the measurement of thermal penetration in rigid and flexible containers and the expression of the heat absorbed in terms of microbiological lethality. Both real time and post processing calculations were performed. A manual has been written but will not be published until 1993.

#### G. Listeria in Crab Processing Plants

Two 1 day programs were presented on Listeria in crab plants during January, 1992. The programs were attended by crab processors and health regulatory agency representatives from North Carolina, Maryland, and Virginia. A substantial portion of the program was devoted to the use of the crab sanitation program previously discussed in this report. A

demonstration was held to further illustrate the important role of computers in firm management.

### 3. Aquaculture Enterprises

#### A. Financial Planning and Analysis

Two 1 day workshops (Appendix V) were presented in Fredericksburg, VA and Annapolis, MD on financial planning and analysis for aquaculture enterprises at an aquaculture conference. A third program was presented at the East Coast Fisherman's Trade Show in Ocean City, MD. The programs utilized the mid-Atlantic case study to demonstrate financial marketing, and production planning over the operation cycle. This program included all aspects of financial matters related to the profitability of an aquaculture firm. All attendees had access to a personal computer so that the impact of changes in spreadsheet values could be readily observed on profitability. While this program focused on the advanced use of computers, most of the attendees were not computer literate and the program served as a basic computer training program.

#### B. Bivalve Culture in the Mid-Atlantic

A seminar was presented on financial resources for spreadsheets. The purpose of the program was to illustrate the impact of debt on firm profitability. All attendees had access to a computer and were able to observe how debt affected a firm's overall financial stability. This program also served as a basic computer training effort to explain the use of spreadsheets and demonstrate the various program commercially available.

## VI. EVALUATION

### A. Original Project Goals and Objectives

The project was amended to include fishing operations and present a more rigorous program over that previously planned. The Part I and Part II program were originally intended to run consecutively but an unanticipated two year delay was experienced. In the interim, most seafood processors purchased personal computers for their business operations and were more advanced than the originally prepared program anticipated.

Additionally, changes in state and federal policy concerning the various components of the seafood industry provided an opportunity to present computer training programs and concepts that could have direct and immediate use.

## B. Accomplishments

The accomplishments of the program are both immediate and long term. The seafood industry rapidly adopted computer technology at the conclusion of the Part I. project. The Part II. project focused on advanced computer concepts and encouraged firm managers and supervisors to develop an expanded concept of how computer technology can increase management's efficiency and effectiveness. The basic concept of the project was to ultimately affect firm profitability.

Specific accomplishments accrued to each activity are as follows:

1. The sanitation chapter in the NFI's HACCP training manual will be used by educators throughout the United States in presenting courses on quality control and assurance programs based on the HACCP concept. Additionally, the information contained in the chapter will be used by firm management personnel in employee training programs.

2. The concept of a computer database on product quality as contained in the clam and catfish program was presented to Mr. S. Wilson of the National Marine Fisheries Service (NMFS). While the NMFS does not currently permit the use of electronic databases in the inspection program, Mr. Wilson agreed that such a concept has future potential. For example, processors could transmit quality information on a regular or infrequent basis to the federal government as part of a mandatory or voluntary inspection program. This would eliminate the need for frequent in-plant visits and provide for greater oversight on a processing firm's operations. It is envisioned that this type of system could be used in rapidly transferring information on product quality to customers before a product arrives, providing reports on product quality to suppliers, and presenting the quality of product workmanship to plant employees in an orderly and organized method.

3. The blue crab sanitation program is being implemented in all Virginia crab processing plants through a cooperative program involving Virginia Tech, Virginia Health Department, and Virginia Division of General Services. Financial support for the activity was provided by a \$50,000 grant from the Virginia General Assembly. Also, the program is currently serving as a major part of a Temporary Restraining Order (TRO) issued by the federal court to a Virginia processor. The processor must follow the program for 5 years before the court can be approached for a rescission request. Other crab processors (Gulf coast) who have faced similar legal action without the program, have been required to make extensive renovations in their physical plant facilities.

4. The programs designed for fisherman have resulted in substantial savings due to a reduction in lost fishing gear. Also, a small business has been formed on the sale of the gear hang identification program. The cooperating vessel operator has reported that record keeping efficiency and accuracy has improved with implementation of the business program.

5. The clam and fish programs have been used by several firms and they have reported favorably on their utility. The clam program is currently being rewritten and should be available for general release in the immediate future.

6. The catfish program will be used in a cooperative venture between Virginia tech, Auburn University, and Mississippi State University on the identification and control of pathogenic microorganisms in catfish processing facilities. Funding for the project was provided by a U. D. Department of Agriculture grant (approximately \$200,000) through the Southern Regional Aquaculture Center (SRAC). The program will be initiated in April, 1993 and last for 12 months.

7. The F value information presented in the pasteurization workshops is currently being used by firms pasteurizing crab meat and also applying a thermal process that is lethal to Listeria monocytogenes. It is anticipated that the use of a listeriacidal thermal process will increase as the FDA increases its field surveys for the organism's presence in fresh products. Eighty-seven seafood processors and fedeeal and state health regulatory officials attended the two workshops.

8. Aquaculture firm managers were able to observe how business decisions and debt affect the profitability of an enterprise. They also were informed of the need to develop firm business plans based on actual projections on cash flows. Requests for presenting this program are continually received and over 120 individuals and government officials have been trained to date.

9. The Listeria training programs were attended by 92 individuals representing the seafood industry and seafood regulatory agencies. This program was later followed by a national meeting on Listeria is fseafood processing firms sponsored by the NFI and Sea Grant.

#### C. and D. Benefits to the seafood industry

The seafood industry was the major beneficiary of all the educational programs. The industry readily accepted the advanced computer concepts and have requested additional training programs. Recent requests have included a demonstration of the application of computer based preventive

maintenance programs. The Marine Advisory Service and Cooperative Extension Service personnel can not meet all the requests for computer assistance. Since the program was initiated in Virginia, producers and processors on the East and Gulf coast have requested copies of the programs when they are available for distribution. Requests have been received from Maine where a processor wishes to modify the blue crab program to accommodate sand or rock (Cancer irroratus) crab processing. Also, a request from Nova Scotia, Canada was received to modify the crab program for Atlantic or Maine lobster processing.

Computer technology offers processors an opportunity to be immediately informed on issues relative to quality and sanitation in their firms. It is anticipated that current regulations on food safety and waste disposal will increase with major impacts on current plant operation and record keeping. The blue crab program which was used in the Consent Decree save the firm an estimated \$90,000 in physical plant repairs. In addition, the catfish program will serve as an important part of the tri-state cooperative study on catfish quality.

Because of the importance of computers in the seafood industry and the interest expressed by processors, a Sea Grant position for a computer programmer will be filled at Virginia Tech in 1993. This individual will be available to the food technology and business specialists as well as the communicator.

#### E. Federal assistance necessary

Federal assistance was required to assist the industry with this raining program. Most of the seafood firms are small having limited financial resources and no technical staffs. If the program were funded by large firms, the information would be considered as propriety and therefore not available to the entire industry. The current economic situation in the seafood industry makes it unlikely that processors would join together to arrange for group funding. However, as the seafood industry adopts computer technology, they will be in a position to assist in the development of computer programs so that the federal government will not be responsible for funding such projects in the future. Funding provided by the federal government at this time will have a major impact in enhancing the use of computer technology in the seafood industry.

## VII. CONCLUSION

### A. Conclusion of the work performed

As a consequence of this project, seafood producers and processors have an improved appreciation of the applications of computer technology in their business and processing operations. During this project, they were able to use computers to: store and recall information related to product quality; develop, modify, and rapidly produce comprehensive plant sanitation programs; and determine how business decisions affect firm profitability. The seafood industry also benefitted for the project in that it served as the basis for the development of one in-state and one tri-state program designed to improve product quality. Both of these programs were funded by grant dollars which resulted in substantial financial savings to the industry. Also, without the extramural support the industry may not have been able to arrange the required funding.

The project also resulted in one firm being able to remain in business since a sanitation program was available and acceptable to the FDA.

The program on computer literacy and the application of computer technology to seafood business and technology will continue as a consequence of the Foundation funding. The grant also provided an opportunity for an educational institution to expand their educational programs to include computer technology. The 1993-94 Virginia Sea Grant proposal contains a new section on Information Systems and Technology which is basically a computer based programming effort.

### B. Success of the project

The completion of this project was considered to be highly successful in achieving the stated goal and objectives of the proposed work.

### C. Need for further work

There is a significant need for further work in the area of computer training and software development. This project served as the initial effort which can have an important impact on the industry. The seafood industry faces increasing financial pressures from international markets and federal and state regulations. Computer technology can provide an opportunity to have greater control over business operations and can serve an important role in controlling the various technical and scientific challenges. This project has served an important function by stimulating the industry to obtain greater information on computer technology and providing an

educational institution with financial support which served as a catalyst to include computer applications in seafood and aquaculture as a major programming effort.