Voice Information Response System for Business Permit Assistance

Office for Regulatory and Management Assistance*

CTG Project Report 95-1

Office for Regulatory & Management Assistance is now the Governor's Office for Regulatory Reform.

Center for Technology in Government
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Project Report

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David Andersen
Peter Avery
Stephen Hyde
Kristine Kelly

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Executive Summary

Each year, more than 33,000 people receive business permit assistance over the phone from the Office of Regulatory and Management Assistance (ORMA).[1] To answer the variety of questions posed by callers, ORMA Permit Coordinators rely on a database describing nearly 1,200 permits issued by more than 40 different New York State agencies.

Since its inception in 1979, the Permit Assistance Program has responded to more than a quarter million inquires from every state and 25 foreign countries. But, by 1993, increasing demand and decreasing funding combined to produce a serious customer service problem: only 16% of incoming calls were answered on the first try. The rest received a busy signal.

ORMA brought this problem to the Center for Technology in Government, seeking a solution which would use more sophisticated voice response technology to meet the needs of its customers. The proposal was accepted as one of four competitively selected projects initiated at CTG in 1993. The overall goal of the project was to increase both operational efficiency and service quality. Specifically, the project sought to investigate the range of available advanced voice information and response technologies and to build and evaluate a prototype integrated voice response solution that would offer clients faster and more consistent service.

The project evaluation assessed technical feasibility, cost-effectiveness, customer service implications, and fit with existing ORMA operations. It also produced indicators about how to improve the larger multi-agency system that New York State uses to disseminate business information to its citizens.

For ORMA, the project achieved the following results:

- The prototype successfully demonstrated a voice response system that can be easily integrated into its existing phone response system. The project showed that speaker-independent voice recognition (SIVR) is an effective alternative input method for callers who do not use a touch tone telephone.

- The complex information needed to obtain business permits can be automated within the context of a voice response system and delivered to callers by both voice messages and fax-back delivery of hard copy.

- In the experimental evaluation, both those who called the prototype automated system and those who called ORMA and spoke with Permit Coordinators were generally satisfied with the service they received.

[1] ORMA is now called the Governor's Office of Regulatory Reform.

- Business permit information is complex and the *process* by which information is transferred from the agency to its customers is at least as important as the accuracy and completeness of the information content. Regardless of the method used during the experimental evaluation (prototype system, ORMA Permit Coordinator, or unassisted search), the accuracy and completeness of the information transfer process was low. In addition, under all tested conditions, callers had difficulty identifying and completing all necessary referrals to other agencies. We believe the fax-back feature (which was not available during the experiment) will help alleviate this problem. However, it remains an area of uncertainty and should receive continuing attention as ORMA moves forward with this initiative.

- When the project began, ORMA managers wanted to use an advanced voice processing system to process all permit-related inquiries. During the project, ORMA staff learned how to achieve a higher return on investment by automating only the most routine and most numerous inquiries. They also developed an appreciation for the complicated dynamic links among call volume, lines, ports, staff, and software that will continue to shape their ability to deliver high quality services.

- Development of the menu scripts for the prototype system required detailed analysis of the information solicited from a caller by the Permit Coordinators when responding to an inquiry. When this analysis was completed, ORMA staff realized that not only had they produced the menu scripts, but that they could use the logical structure of the scripts as the basis for in-house training materials to orient new staff in the most efficient ways of soliciting information from callers.

- ORMA was aware that, in most information systems projects, the future costs of application maintenance could be quite large, particularly in a field where changing regulations and permit requirements would require frequent modification of the application. Working with the project corporate partner, Precision Systems, Inc., staff learned how advanced software development tools can help reduce labor costs associated with modifying and maintaining the application to accommodate changes in procedural and substantive regulatory content.

- Due to the knowledge gained through participation in this project, the agency was able to commence procurement of a new system much earlier than would otherwise have been the case.

By carefully employing voice response technologies as demonstrated through this project, many public agencies can aim to increase customer contacts, provide faster responses, offer greater availability of services, improve client satisfaction, lower operating costs, and provide a higher and more consistent quality of service. Any agency which processes applications, claims, or other similar transactions could use this technology to its advantage. The project produced important general lessons that can be used by other public agencies as they explore this technology. Specifically:

- The cost effectiveness of voice-response technology cannot be calculated or understood by a simple formula. It depends on complex interactions among call volume, telephone lines and ports, number of staff, and the specific automated information products. Such systems should be dynamically modeled before development so that these relationships are well-understood before investments are made.

- Much work remains to be done in exploring the factors influencing the accurate and complete reception of information disseminated by an automated voice processing system. In this case we learned that although the prototype proved effective in *transmitting* information to the experiment participants, there was a much lower degree of accuracy and completeness of the information *received* by the participants. Any agency considering such a system should take special care to address this issue.

Finally, the project produced some indicators of interest to state policy-makers as they seek to make New York a more hospitable environment for business development.

- The existing pattern of state regulatory requirements offers substantial opportunities for cross-agency coordination and process reengineering. It appears that ORMA's business assistance mission does help business entrepreneurs understand and navigate through the regulatory environment. However, half or more of the participants in the experiment said that doing business in New York was more complicated than they expected. The data also suggest that citizens are dissatisfied with the large amount of personal effort it takes to meet regulatory requirements once identified.

- Clients may be willing to pay substantial fees for higher levels of service. Participants in the experimental evaluation indicated a uniform willingness to pay fees for more personalized assistance with permit requirements. These hypothetical services all reflected some level of integration among a variety of currently separate requirements.

1. Project Overview

Imagine that you and a friend are considering a partnership to open a small retail business in a newly vacant building. On the first floor, you would like to sell gifts and crafts, some made by friends in the area, others imported from Mexico, Guatemala, and South America. On the second floor, you would like to have a bookstore-café with tables, espresso machines, gourmet coffee and desserts. You will not sell any alcoholic beverages or tobacco products. You may carry roses or bouquets from the florist down the street. You will be hiring two full-time employees at the onset and expect that more will be needed. Having watched a few friends go through the process of opening a business, you are aware that you will need to obtain permits from various government agencies. Would you know which ones?

Compliance with State license and permit requirements is essential to the success of any business or non-profit undertaking. Since 1979, New York State has offered a Permit Assistance Program to help entrepreneurs begin or expand such enterprises. Since its inception, the Permit Assistance Program has responded to more than 264,000 client inquiries from every county in the State, every state in the union, the District of Columbia, a number of US possessions, and over 25 foreign countries. It has collected and updated permit information from over 40 New York State agencies, and has provided, via a toll free telephone line, individualized assistance on nearly 1,200 business-related permits free of charge to new and expanding organizations of all sizes. A cadre of Permit Coordinators provides clients with information regarding filing procedures, fees, time frames for determination, and common reasons for denial. When appropriate, the program provides Permit Assistance Kits that include application forms, instructions, and useful information about required permits. The assistance provided and the method of supplying information to clients, however, is as varied as the inquiries received. Many callers' questions are answered on the spot during the interview with the Permit Assistance Staff, while other more complex inquiries may require extensive research and subsequent follow-up.

The Permit Assistance Program is the oldest, most mature and most widely recognized program of the Office for Regulatory and Management Assistance (ORMA, now the Governor's Office for Regulatory Reform). The foundation for the program, found in Section 887 of the Executive Law, directs the Office to provide free permit information, coordination and assistance service.

At the high point in staffing, ORMA had seven full time professional Permit Coordinators, but because of statewide fiscal problems over the past several years, staffing levels have been reduced to a total of four full time professionals. Client inquiries have not stopped, however, but continue to increase in every year of operation. As a result, by 1993, 84% of incoming calls received a busy signal. In order to transform the way its Permit Assistance Program operates and to allow the agency to redeploy its limited resources to other program areas, ORMA proposed a project with the Center for Technology in Government to investigate advanced interactive voice response and information technologies. ORMA expected that an interactive voice system would increase client contacts, provide faster response, offer greater availability of services, increase personnel productivity, improve client satisfaction, reduce operating costs, provide a higher and more consistent quality of service, and allow the agency to move ahead with its increased management and regulatory assistance efforts.

ORMA's Current Operations

To meet the demand for increased services with fewer resources, ORMA turned toward information technology. The Office initially began implementing automated systems in its Permit Assistance Program in 1990 to enable staff to respond promptly, accurately, and efficiently to a rapidly expanding base of clients. As the fiscal situation in the State changed, the focus of system development efforts changed as well. Efforts were concentrated on how to provide a high level of service to an increasing client base during a period of shrinking resources.

As the agency began reviewing its operations and automating more of its services, it realized that it had to change the way it did business. A valuable first effort in this re-engineering process has been ORMA's automated Voice Information Processing System (VIPS). This system answers incoming telephone calls and offers the caller a menu of informational topics from which to choose. Since its implementation in November 1990, the VIPS system has answered more than 106,000 calls. Almost 33,500 of those callers were provided assistance without having to speak with a staff member. These clients were directed by VIPS to other offices within New York State government for information relating to taxes, how to register consumer complaints, how to obtain financial assistance, and other non-permit related issues. The remaining clients were routed by VIPS to a Permit Coordinator (during normal business hours) to obtain assistance with permit related issues. After-hours callers were given the opportunity to leave their name and message on an answering machine for follow-up by a Permit Coordinator during regular business hours the next day.

The ORMA Permit Coordinators rely upon a database containing information on the nearly 1,200 permits issued in New York State. The permit assistance information base comprises a set of separate documents for each type of permit issued by a New York State agency. Each document contains information about the applicability of the permit, the requirements, fees, procedures, and related topics. This massive information base was created in-house by ORMA staff. The information is made more accessible by a series of menu-driven selection systems. The ORMA Permit Coordinators can locate permit information by selecting from a menu of business models (e.g., food service, manufacturing), regulatory agencies, or other menus reflecting different methods of classifying the vast amount of permit information. The documents which individually describe permits and related information have been compiled into five bound volumes by the New York State Bar Association and are available under the title *The Official Directory of NYS Business Permits.* They are categorized only by agency and do not have the multiple indexes built into the ORMA Permit Assistance system.

While the VIPS statistics are impressive for an agency staffed by only four full- time Permit Coordinators, ORMA has not been able to employ the system to full advantage. In late 1993, ORMA enhanced its 800 service to include more detailed monthly billings. Upon review of those billings, ORMA found that a monthly average of more than 19,000 calls to its toll free number received a busy signal and were not completed. Less than 3,700 callers, or 16% of those calling on the 800 line, actually got through. ORMA deduced that not all 19,000 incomplete calls represented different clients, but that they represented some 4,000 to 5,000 clients who were repeatedly calling back after receiving a busy signal. To reduce the number of busy signals and to capture the incomplete calls, ORMA would have had to install additional phone lines. However, it did not have the staff or the resources to answer the additional calls that the new lines would have allowed into the system.

One limitation of the VIPS was that it acted primarily as a phone attendant, providing clients with only very basic information that was, for the most part, not business related. Callers seeking business assistance were required to wait to speak with a Permit Coordinator. As shown in Figure 1, one third of the callers using the VIPS were seeking general governmental information and assistance, such as tax information, financial assistance, employer information, information on where to register a variety of complaints, or they needed to contact another agency but did not know how to identify or contact it.

Another limitation of the VIPS was its ability to respond only to touch tone telephone signals. If a caller did not have touch tone service, or failed to use it, the call would be automatically routed to a staff member. About one third of the callers (approximately 34,000 of the 106,000 callers to the system) did not have or did not use touch tone commands to request service. These calls were transferred to Permit Coordinators, yet many of these did not have permit-related questions and could have been handled by the telephone attendant. Of the remaining two thirds who had the required equipment and used it, nearly 50% requested permit assistance from a Permit Coordinator.

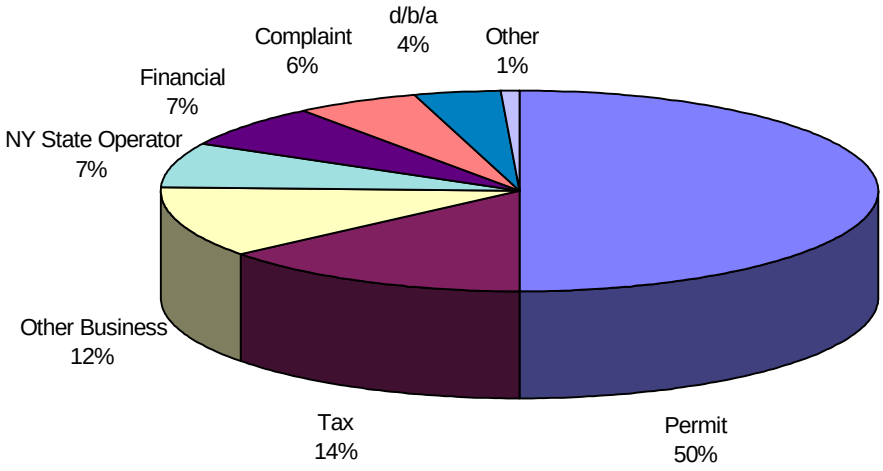

Figure 1
ORMA's Incoming Calls by Type
1993

As ORMA's mission continued to grow and change, it considered redeployment of staff, re-engineering of programs, and the use of more advanced technology to help meet its current and future program needs, improve service delivery, and increase its operational efficiency. Since hiring additional Permit Coordinators was not possible, ORMA decided to explore an advanced voice processing system with the capability of giving out a wider variety of information (especially information relating to business permits) to an increased number of callers who might or might not have touch tone capabilities. This type of system would enable ORMA's existing staff to respond to 4000+ additional clients each month.

Figure 2 depicts the logical routing of calls through ORMA's current system and shows (in the bold diamond) how ORMA planned to deploy this enhanced capability.

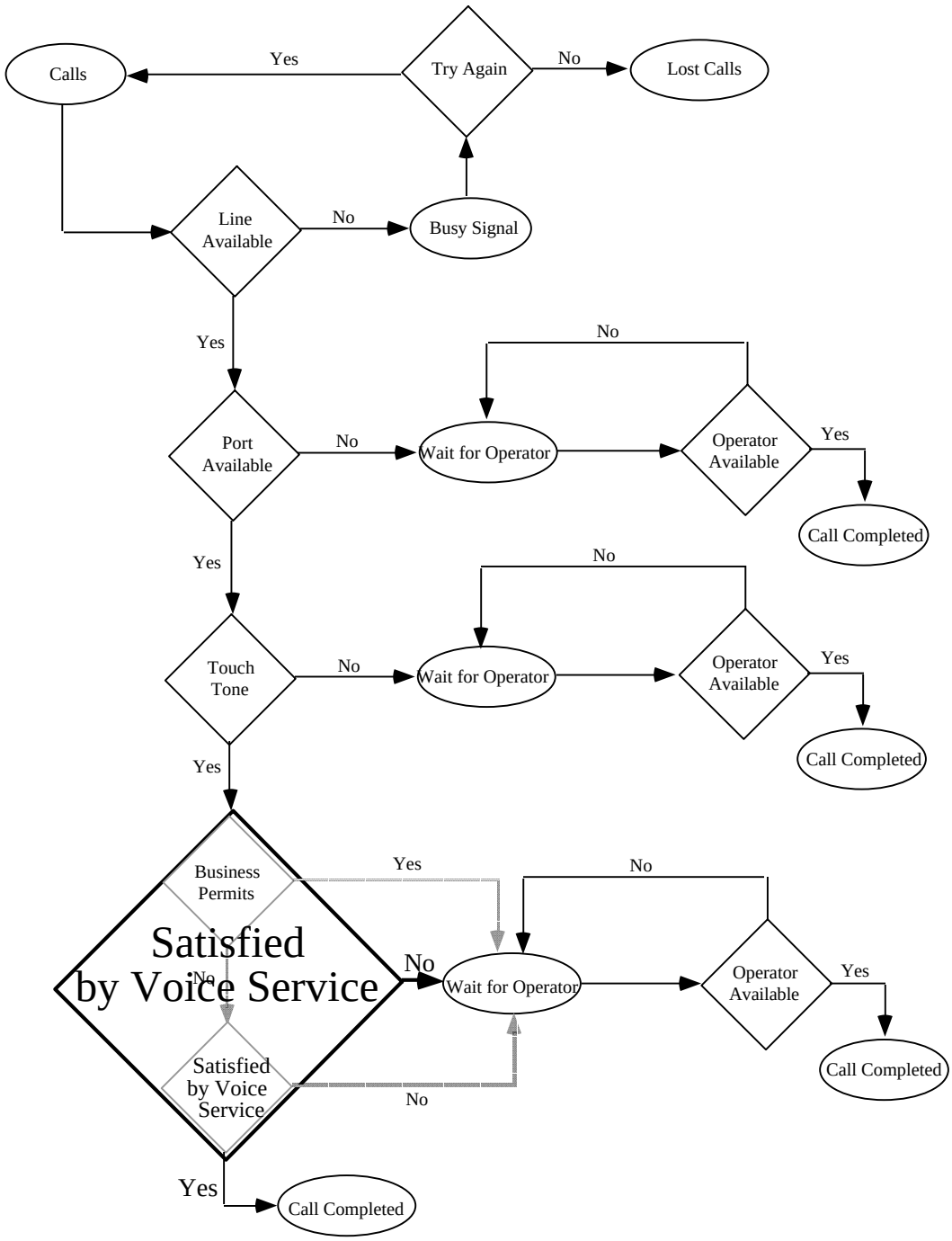

Figure 2: Logical Flowchart of Call Processing
The Effect of Automating Business Permits

Center for Technology in Government Project

The goals of the CTG project were to enable the agency to increase operational efficiency in its Permit Assistance Program, increase the quality of services provided and expand the array of services available.

Project Objectives

The primary objectives of the project were to:

1. Investigate the range of available advanced voice information and response technologies and how they can be integrated into client services offered through the Permit Assistance Program.

2. Design, develop, and prototype an integrated voice response solution that will enable the Permit Assistance Program staff to better focus their efforts and offer clients faster and more consistent responses to inquiries and greater availability of services.

3. Enable clients to prepare their own business Permit Assistance information kits by directly accessing ORMA's Permit Assistance database using their own telephone equipment as an input device

4. Evaluate how well the integrated voice information and response solutions meet the needs of ORMA clients

The original project objectives focused sharply on the process of developing, installing, and evaluating a prototype automated business permits system within ORMA. As this process progressed, it became increasingly clear that in addition to those questions associated with the prototype technology itself, a number of other issues centering on how this new system would fit into existing processes, procedures, and technologies within ORMA also needed to be addressed. In turn, ORMA's existing program is just one part of the larger system that New York State uses to disseminate business information to its citizens. Citizens who call ORMA actually need to do business with other agencies. Their goal is to understand and deal with the relevant regulations of local, state, and federal government entities. Hence, the scope of the project evaluation effort was expanded to include these issues (CTG.ORMA-006).

The project was designed to demonstrate how voice processing and response technologies could be employed by agencies that face diminishing resources and growing requests for services. ORMA was looking toward the implementation of fully automated Permit Assistance services not only as a way to increase efficiency of operation, but also as a way to increase the quality of its services and to redeploy Permit Assistance staff to new program areas. Not only would ORMA and its clients benefit from advanced voice information and response technologies, but the service provided to agencies such as the Departments of State, Taxation and Finance, Labor, Economic Development, the State Insurance Fund, the Workers Compensation Board, localities, and Federal agencies would also improve.

ORMA staff believed that such a system could replace Permit Coordinator positions with lower level professionals resulting in annual personal service savings of approximately $30,000. Additional savings could be realized through the use of advanced systems for client follow-up where Permit Coordinators would no longer be required to prepare follow-up surveys or to request and record a variety of client demographic information for input to ORMA's statistical reporting system.

In summary, services to clients could be improved through the use of a 24-hour system capable of answering more incoming lines, offering callers the ability to customize their own packets of information, connecting them to appropriate program areas outside the agency, and soliciting client reaction to the services that they received. Staff would be able to concentrate on providing quality service to clients who had been appropriately referred to them by the enhanced voice processing system, or who had left messages

when permit assistance personnel were unavailable. The system would distribute work more evenly and promote a more positive image of the agency and the State as a whole.

Project Workplan and Participant Roles

CTG followed a five-step process in managing this project: planning, prototyping, analysis and modeling, evaluation, and leveraging results.

1. Planning. At the outset of the project, CTG met with those ORMA staff members who had been designated as the agency's project team. (See Appendix B "Project Participants" for a list of project team members.) Following this introductory session, the CTG Project Coordinator visited ORMA headquarters on several occasions to gather more technical information concerning the current system.

A facilitated planning meeting was held in March 1994. The purpose of this meeting was to identify, through a formalized technique of elicitation and prioritization, the ultimate goals for an advanced voice processing system and to establish functional priorities for the prototype version of that system.

By describing a fully implemented system in this way, ORMA identified many possible benefits. The group also examined how the agency might ultimately describe and measure its success, who would be impressed, and what information should be delivered by what means. Finally, key components for the prototype and for the final system were defined in the areas of management tools, operating policies, human resources, and technology.

As an early part of the planning process, CTG staff completed a literature search on telephone answering and voice activated systems to provide background to project managers and to examine a number of specific questions posed by ORMA. The results of this benchmarking literature are summarized in Appendix E and available in a separate report (Giguere, CTG.ORMA-004).

2. Prototyping. During the planning sessions, the project participants determined specifications and functional requirements for both the prototype and the fully implemented system. Among the most salient desired features for the prototype were:

- It should include business permit information for one industry (e.g., wholesale; manufacturing) and those business types within that industry that are responsible for the highest numbers of calls.
- The number of busy signals received by callers should be greatly reduced or eliminated.
- By using speaker independent voice recognition technology, callers should no longer need touch tone equipment to use the system.
- Callers should be able to prepare their own permit assistance kits using their telephone as an input device and to receive those kits via automatic fax-back delivery.

In addition to those features in the prototype, the fully implemented system should be able to:

- Capture client-supplied demographic information, automatically call clients back to solicit follow-up information, and allow clients to leave messages for staff when they are unavailable.
- Capture all interactive voice response activities for statistical reporting purposes.
- Serve as a front-end for other agencies by allowing a direct dial capability (call routing) to those other agencies.

Precision Systems, Incorporated provided the hardware and software for the prototype and worked with CTG and ORMA to develop the necessary voice menus and information scripts. The menus enable callers to navigate through the prototype to locate the precise information they require. By answering automated questions (e.g., "Are you going to open a retail establishment?"; "Will you sell cigarettes?") the voice processing software application gathered all the information needed to provide a complete and accurate summary of the permits required and the agencies and fees involved in obtaining those permits.

A description of the hardware and software platform used in the prototype is contained in Appendix C.

3. Analysis and Modeling

A. Cost Performance Modeling Conference. During October 1994 a team of researchers from CTG met with senior ORMA staff responsible for the Permit Assistance program. At that time, substantial progress had already been made in creating a prototype system. The purpose of this conference was to analyze the costs and benefits of providing business permit information through an automated system. This group modeling conference elicited the costs of the new system in terms of hardware, software, and data entry, plus miscellaneous expenses such as postage and copying associated with mailing out or faxing packets to callers. The conference also elicited the costs associated with providing this same business permit information through Permit Coordinators.

A significant portion of this conference was spent estimating how long it would take to serve a caller through an automated system versus by a Permit Coordinator. At low volumes of calls, it was clear that Permit Coordinators could be more cost effective than an expensive automation project. However, at higher volumes, the pay back for automating could be very high. But where was the break-even point between hiring more Permit Coordinators and moving toward automation? How did the acquisition of an automated business permit system interact with a perceived need to expand the present voice response system? That is, what types of technology should be purchased first? And finally, how would these decisions to acquire more Permit Coordinators, more voice equipment, or an automated voice permit system vary as the volume of calls increased? (For a full report of the Cost Performance Modeling Conference, see Andersen and Rohrbaugh, CTG.ORMA-005.)

B. Process Simulation Model of Automated Permit Assistance Procedures. In order to answer these questions, CTG constructed and analyzed a system dynamics simulation model of ORMA's Permit Assistance program. The full report of that study is available as a separate document from CTG (Mojtahedzadeh and Andersen, CTG.ORMA-007). Between November 1994 and February 1995 the simulation team worked with the results of the October conference as well as with additional data provided by ORMA.

The model simulated incoming calls including busy signals, call backs, prescreening, and information dissemination by the automated Permit Assistance system; calls forwarded to Permit Coordinators; and the client service activities of those Permit Coordinators. The simulation indicated that with the current VIPS, ORMA's information dissemination performance by telephone is significantly lower than it could be. Within a simulated environment, this model then explored the implications of hiring more Permit Coordinators, adding more telephone lines, and adding more ports to support the voice response and automation system. The model also explored the implications of adding these various types of capacity in the face of differing levels of customer demand for information - current volume, doubling the current volume, and tripling the current volume. The simulation analyzed Permit Coordinator utilization, client waiting times for service, total call volume, estimated number of lost calls, and other variables relevant to the operation of the Permit Assistance program.

Analysis of the model results indicated that:

- ORMA's first step should be to increase the capacity of its current telephone system from eight lines to 24.

- If calls remain at the current volume, hiring on additional Permit Coordinator would be more cost effective than automating business permit information.
- As call volume increases, automating business permit information becomes a cost-effective long-term investment.

4. Testing and Evaluation. Whereas the prototype development process focused primarily on technical issues and the cost performance and process simulation models focused primarily on measuring and analyzing system efficiency (volume, costs, capacity constraints, and utilization), a final effort concentrated on looking at the relative effectiveness of various approaches to disseminating business permit information. During January - March 1995, CTG conducted an experimental evaluation of how well ORMA's Permit Assistance program met the needs of clients.

Under quasi-controlled circumstances, approximately 60 people (most of them graduate students in Business and Public Administration) were directed to find and report on permits necessary to start one of six types of businesses. The six business types chosen were ones for which the existing prototype system could provide the necessary information: grocery stores, restaurants, gasoline stations, gift shops, and mail order/telephone order businesses. These sixty callers were divided evenly into three groups--one group of twenty was directed to use the prototype system, one group was directed to call into ORMA's existing system (eventually connecting to Permit Coordinators), and the final group was given no information about the existence of ORMA and was told to solve the problem of getting permit information using whatever other information sources they deemed appropriate (e.g. the public library or the phone book). All participants in the experiment were asked to limit their search to two hours. Participants turned in an answer sheet that described what permits they needed to start their assigned business as well as what forms and fees would be required. In addition, all participants turned in a time log demonstrating how they used their time and they completed an extensive survey to find out their reactions to doing business with New York State. Participants were paid twenty dollars for completing the experiment.

The experiment gathered information on the accuracy and reliability of the information gathered, on participant satisfaction with the information search process and the service they received and on their willingness to pay a fee for several enhanced levels of service that New York State or ORMA might provide in the future. The complete details of the experiment and participant survey are contained in a separately available report (Andersen, Avery, Hyde, Kelly, and Kim, CTG.ORMA-009).

5. Leveraging Results. As with all CTG projects, one of the final stages of the ORMA project was a public demonstration. Nearly 100 people, representing twenty-two state agencies, heard ORMA project participants describe the business problem that gave rise to the project and saw a brief demonstration of the Precision Systems, Inc. rapid development tools. They then “listened in” while a call was placed to the prototype and then saw appropriate business permit information immediately come back via fax.

CTG has also prepared a set of reports detailing the major stages of the project. The complete list of reports regarding the ORMA project is presented in Appendix D.

Because the technology involved in the ORMA project will be of interest to many other agencies, CTG is also preparing seminars and tutorial materials to assist those who may wish to learn about this technology and the planning required for a successful implementation.

2. Project Results

Project results fall into four main categories:

1. Technical feasibility of voice technologies,
2. Cost effectiveness of the prototype solution,
3. Customer service implications,
4. Observations related to New York's overall business climate.

1. Technical Feasibility

The prototype demonstrated a voice response system that could be easily integrated into the existing phone response system used by ORMA. The enhanced prototype system contained voice response features, fax-back features, and an automated business permits information module for the "Top 5" business models. The UniPort platform on which the prototype was built interfaces with a standard T1 telephone connection. Each T1 line is the equivalent of 24 ordinary telephone lines. ORMA can install 2 T1 lines, giving the system access to 48 incoming calls at one time.

The prototype successfully used speaker-independent voice recognition (SIVR) as an alternative input method for callers who did use a touch tone telephone. The SIVR was capable of understanding the spoken digits "Zero" (it would also accept "Oh") through "Nine," and the words "Yes" and "No." An alternative form of voice recognition, speaker dependent voice recognition (SDVR), was also investigated. In general, SDVR can recognize a wider vocabulary than SIVR, but it needs to be "trained" to understand different voices. Because this was impractical for an agency that serves many thousands of individual callers, SIVR was chosen.

The prototype demonstrated the feasibility of disseminating information to callers by both voice messages and fax-back delivery of hard copy. The UniPort system is capable of using prerecorded voice files for delivering information to callers, and can convert textual files (such as the ORMA permit assistance database) into spoken speech (text-to-speech). The prototype design utilized prerecorded voice files since text-to-speech technology does not yet produce a speech sounding as lifelike as prerecorded voice files. However, when ORMA implements a complete system, text-to-speech may prove better suited since no additional modifications would be needed when changes are made to information in the Permit Assistance database. If prerecorded voice files are used in the final system, they will have to be re-recorded to match changes in the information contained in the permit assistance database.

The prototype demonstrated that the complex information needed to obtain business permits can be automated within the context of a voice response system and made available over the phone to clients. Through carefully constructed menus, callers can move through the system, responding to the automated menu queries by pressing the appropriate touch tone keys on their telephone or by speaking the appropriate number or the words "Yes" or "No," thereby indicating the type of business they are starting as well as other information that affects the type of permits required. In the same way, the caller can indicate whether he or she wants a hard copy of the information faxed back, or leave a message with a name and address to which the material can be mailed.

The call routing and fax-back features of the automated system should reduce customer effort and waiting time but these features were not formally evaluated. Through the use of call routing, a caller can indicate if she wishes to be transferred to a different agency without having to hang up and dial a different number. This capacity requires an additional component, known as a front-end switch, to be added to the system. Call routing is available on the Precision Systems, Inc. UniPort system, but due to the expense involved in obtaining a front-end switch, call routing was not part of the prototype and its effectiveness has not been evaluated.

The prototype did contain a feature that would enable clients to receive their own customized business permit assistance information kits by fax. The information faxed to the caller would contain a one-page document for each type of business permit required. These documents mirror the actual records currently contained in the ORMA permit assistance database. The particular package of information received by the caller would be assembled by the UniPort system in response to the caller's menu selections and verbal or touch tone responses to inquiries from the system. Additionally, the caller would receive a faxed memo indicating any necessary additional steps, such as how to obtain a Federal Employer Identification Number from the Internal Revenue Service, or how to file incorporation papers. The fax-back feature was successfully incorporated in the prototype developed for the project. However, this feature was not operational during the time that the prototype was being evaluated, and therefore its impact on client reaction to the system has not been assessed.

2. Cost Effectiveness

Cost effectiveness depends on complex interactions among call volume, telephone lines and ports, number of staff, and automated permit information. The Process Simulation Model explicitly analyzed varying combinations of telephone lines, port capacity, number of business models for which automated information is available, and number of Permit Coordinators (CTG.ORMA-007). A complicated set of relationships exists among these various capacities.

When considering the hiring of additional staff or the purchase of additional equipment of any kind, ORMA must carefully analyze which types of capacity are slack and which are fully utilized. For example, in the base run of the Simulation Model (which represents ORMA's current configuration of Permit Coordinators, telephone lines, and computer ports), hiring an additional Permit Coordinator without expanding the number of additional phone lines or ports would be relatively ineffective. This is because a relatively higher rate of marginal productivity of Permit Coordinators could be achieved with the addition of more telephone lines and ports that would support call screening features and therefore free Permit Coordinators to address the more complicated calls. At this base volume, Permit Coordinators could not effectively be traded off for automated permit assistance for the Top 20 business types. However, at higher volumes of calls, an automated permit assistance system, similar to that of the prototype, could replace Permit Coordinators if the appropriate number of lines and ports were in place. In short, the relationships between types of capacity are complex and need to be carefully analyzed prior to the acquisition of additional resources.

The process simulation model also indicated that the present ORMA system is capacity constrained. Hence, adding lines and ports (and eventually Permit Coordinators) will relieve pressure on capacity. This will make it easier for callers to get through which could lead to the higher call volumes which will cost justify further automation. While these effects of capacity constraint were discussed in the simulation model analysis, they were not formally analyzed since the time horizon of the formal model was one typical work day. These reputational effects will most likely take place over a much longer time period such as 18 or 24 months. The model captured these possible effects by assuming, in different scenarios, that calls had increased by a factor of 2 or 3 for various simulation runs.

3. Customer Service

In the experimental evaluation, both those who called the prototype and those who called ORMA were generally satisfied with the service they received. Those who spoke to Permit Coordinators were most satisfied. Eighty-one percent of the participants who called the prototype expressed general satisfaction with the interaction. However, only 53% agreed that it was easy to get information from the prototype system. Seven in ten of those individuals who accessed the prototype system either agreed or strongly agreed that the recorded information was useful and appropriate for their needs. Sixty-five percent of those using the prototype perceived the recorded information to be complete. Forty-one percent enjoyed their interaction with the system.

In general, participants who called the prototype appreciated most that the system existed and that they could get quick and easy access to information with abundant referrals. On the other hand, the number of and hierarchy of options was sometimes difficult to work with and participants wanted more ability to move freely within the menu of available choices. These participants also said they wanted access to more information, usually visual information such as a pamphlet or a hard copy of what was being said over the phone (recall that the fax-back feature was not operational during the experimental evaluation).

One hundred percent of the callers who interacted with Permit Coordinators at ORMA were satisfied with the service they received. This group, which spoke directly with ORMA's Permit Coordinators enjoyed the interaction more than did those who called the prototype. They also felt that it was easier to get the information they needed.

The prototype provided the best quality telephone connections, followed closely by ORMA's 474 line. ORMA's 800 call screening number performed poorly. The number used by the prototype was a commercial 800 service maintained by Precision Systems, Inc. Although service was accidentally interrupted during the first day of the prototype test, 90% of the prototype participants agreed that they had no difficulty getting through and 94% were satisfied with the timeliness of their connection. Nearly 90% of the clients calling the prototype got through the first time they called.

Nearly three-quarters of those who called ORMA's 474 line reported getting through on the first call, while only 7% got through the first time they called ORMA's 800 line. Nine in ten reported no difficulty getting through on the 474 number, and 100% expressed satisfaction with the timeliness of their connection with ORMA's 474 service. These two figures contrast sharply with much lower 44% and 38% satisfaction ratings for ORMA's present 800 phone system.

A caller who interacts with the voice response system spends more time on the phone than the caller who speaks with a Permit Coordinator. The automation of business permit information will most likely increase the amount of time that a client spends on the phone with ORMA. Those participants who called ORMA directly spent an average of 10 minutes interacting with Permit Coordinators and the automated screening system. Those participants who interacted with the prototype spent approximately 39 minutes on the phone. Nine in ten participants calling the prototype had to have options repeated at least once in order to get the needed information. This data seems to indicate that obtaining all of the necessary information from an automated voice system may be difficult. Nearly half of this group thought that the process of obtaining this type of information was too complex to be handled by an automated system.

Regardless of the method used (prototype system, ORMA Permit Coordinator, or unassisted search), the accuracy and completeness of the information transfer process is low. Logically,

the accuracy of information dissemination is a function of two factors - the accuracy and completeness of the information being given out by a source and the accuracy and completeness of the information as received by a client.

Within the context of this experiment, the grading of participant answer sheets demonstrated that for all groups tested, the accuracy and completeness of information transfer was low. The average accuracy and completeness rate for all experimental participants was only 38%. This means that when the information search was complete, the average participant, including those who called the prototype or ORMA, wrote down less than half of the information that should have been collected. The highest score for all participants in the experiment was 74%, indicating that even the best performing participant missed roughly one quarter of the information. Several participants received a score of zero, indicating that after two hours of information searching, they were not able to come up with *any* correct information. Ironically, in light of the relatively low scores for information collection, 43% of all of the participants were either confident or highly confident that they had obtained all of the information that they needed to file for the permits related to their business initiative.

Our analysis assumes that the information encoded in the prototype is accurate and that the knowledge base of ORMA Permit Coordinators is also complete and accurate. This leads us to conclude that the information transfer process needs close attention. Evidence from the experiment suggests several areas for improvement. Participants using the prototype had some difficulty capturing all necessary information as it came to them over the phone. Overall, 61 percent had to have options repeated several times while 89 percent indicated that they had to have options repeated at least once. Those individuals who contacted ORMA directly also had some difficulty navigating their way through the system. One third of the participants who contacted the present VIPS did not report having made contact with a Permit Coordinator. Since it is necessary to contact a Coordinator under the current system in order to obtain the permit information, it appears that these individuals hung up before they got to a Coordinator believing that no further assistance was available to them. Both of these examples point to the importance of attending to the information transfer process as well as to information content.

Under all tested conditions, callers had difficulty identifying and completing referrals to other agencies. In order to obtain the necessary forms for business start-up, ORMA clients must contact a number of additional agencies. Participants in both the ORMA and the Prototype treatments were encouraged to obtain as much information as possible, including forms, from those agencies to which they were referred. For all the assigned vignettes, it was necessary for the participants to follow-up with a minimum of one additional agency.

In both groups, about one quarter of the participants reported that they had not been referred to another agency for either forms or additional information. A smaller proportion of the ORMA group reported having been referred to another agency. For those participants who did report having been referred, the average number of referrals were 5.4 and 4.4 for the Prototype group and ORMA group, respectively. The differences between the groups on the referral question may be attributed to either the level of information given out by the Permit Coordinators at ORMA versus the prototype system, or the manner in which the information is given out by the two mechanisms. The data from the experiment indicates that the prototype system may be more successful in disseminating information about a client's need to contact other agencies. Either the information disseminated by the prototype was more comprehensive, or the manner in which that information was disseminated by the prototype was more easily interpreted or recorded by the participants.

While at least 21% of the participants indicated they were successful in contacting all of the referrals, getting full information, and obtaining all forms, a review of graded responses indicates than none of the respondents actually obtained full information. The high score for all participants on the accuracy and completeness scale was around 75%. A discrepancy thus exists between

individuals' perceptions of the completeness and accuracy of their information search and the actuality that was captured in the grading process.

4. Observations Related to the Business Climate in New York State

Clients may be willing to pay substantial fees for higher levels of service. If ORMA could offer new types of services to its clients, those clients might be able to reduce the amount of time and effort associated with satisfying business permit requirements. A proxy for client time savings was collected in the survey in terms of a willingness to pay for enhanced services. The modal participant indicated a willingness to pay between $21 and $100 for a phone-based service which would provide all of the needed forms and permits in one phone call and between $101 and $200 for a service that would actually fill out the forms based on information obtained from the client during an interview (possibly over the phone).

These results should be interpreted with caution for two reasons. First, the reported data may be biased based on the ranges offered to the participants in the experiment (i.e., $0, Up to $20, $21-100, $101-200, $200-500, $500+). These ranges set fixed bounds on how much one would be willing to pay for the services, but they were not based on any empirical data. Second, the participants were university students being paid $20 to participate in the experiment. Their willingness-to-pay may not be representative of the opinions of actual business entrepreneurs. Nevertheless, fee-based services appear to be acceptable to most participants and should be further evaluated.

Understanding the ways in which citizens learn about ORMA's services may be an important lever for improving public access to ORMA and public perceptions of ORMA's effectiveness. Before the experiment began, participants were asked what search strategies they would use to find business permit information. The phone book was the most commonly cited first source, followed by personal contacts and libraries. During the experiment, a number of participants were referred to ORMA by other agencies including the Small Business Administration and the NYS Department of Commerce. Each of these sources can help direct entrepreneurs to ORMA and its business assistance services. In order to be most accessible to the business community, ORMA should examine where and how it is listed in the phone book and in library resources. It should also reinforce its relationships with related organizations which are sources of referrals.

New York's regulatory environment and business information dissemination services receive mixed reviews. Half or more of the participants in the experiment said that doing business in New York was more complicated than they expected. Two thirds of the prototype group and half of the ORMA group held this opinion. However, nearly three-quarters of the prototype group thought New York State was doing a good job of disseminating business information; 44% of the ORMA group agreed. Not surprisingly, those members of the control group who never made contact with ORMA held the lowest opinions of New York's performance in disseminating business information. It appears that ORMA's business assistance mission, in whatever form, does help business entrepreneurs understand and navigate through the regulatory environment. However, the data also suggest that many are dissatisfied with the amount of personal effort it takes to get needed information and meet regulatory requirements.

3. Value of the Project

Value to the Agency

ORMA is a small agency with limited staff and fiscal resources. Unlike large agencies, ORMA could not call together special project teams from within or redirect its limited budget resources without seriously impacting the services it is obligated to provide. This project required staff resources including experts in voice information and response technologies, a full time Project Coordinator, and assistance in acquiring the necessary hardware and software to serve as a prototype platform for the voice response applications. The Center for Technology in Government provided these outside resources while ORMA provided its own expertise. The combination proved valuable to all participants.

The specific lessons learned by ORMA through participation in this project include the following:

- When the project began, ORMA wanted to use an advanced voice processing system to process all permit-related inquiries. By participating in the Cost/Performance modeling exercises, ORMA staff learned how to achieve a higher return on investment by automating only the most routine and most numerous inquiries. They also developed an appreciation for the complex dynamic links among calls, lines, ports, staff, and software that will continue to shape their ability to deliver high quality services.

- Development of the menu scripts for the system required detailed analysis of the information solicited from a caller by the Permit Coordinators when responding to an inquiry. Depending upon the nature of the business in which the caller was interested, specific questions need to be asked by the Permit Coordinators to ensure that the information given to the caller is accurate and complete. When this analysis was completed, ORMA staff realized that not only had they produced the menu scripts, but that they could use the logical structure of the scripts as the basis for in-house training materials to orient new staff in the most efficient ways of soliciting information from callers.

- ORMA was aware that in most information systems projects, the future costs of application maintenance could be quite large, particularly in a field where changing regulations and permit requirements would require frequent modification of the application. Precision Systems, Inc. demonstrated that advanced software development tools provided a labor saving way for agency staff to modify and maintain the application to accommodate changes in procedural and substantive regulatory content.

- At the outset of the project, ORMA intended to maintain its database of permits on its Unisys mainframe, and use the new voice response platform to query and retrieve data from that mainframe. After consultations with Precision Systems, Inc., ORMA realized that it could transfer its database onto a self-contained system and eliminate the need to interface with the existing mainframe. This was a positive development since the existing mainframe was no longer being supported by Unisys and the current VIPS was suffering an increasing failure rate.

- Due to the knowledge gained through participation in this project, the agency was able to commence procurement of a new system much earlier than would otherwise have been the case.

Value to State and Local Government

The telephone is the means by which most people deal with the government.

ORMA deals with over forty New York State agencies which issue permits. Many of those agencies have programs responsible for responding to client calls by either providing immediate answers to questions or by recording appropriate information to deal with the inquiry at a later time. Agency staff must be prepared to handle the inquiry directly or to route requests for service to the appropriate area within the agency or to another agency for resolution. By employing voice response technologies as demonstrated through this project, agencies can increase customer contacts, provide faster responses, offer greater availability of services, improve client satisfaction, lower operating costs, and provide a higher and more consistent quality of service. For example, the Department of Health might provide emergency health and medical information. Advocacy agencies, like the Office for the Aging and the Division of Veterans Affairs, often receive service requests that are handled by counterpart local agencies. Using voice technologies, such agencies could direct clients to their closest local office automatically. Any agency which processes applications, claims, or other documents could use this technology to its advantage.

In addition, ORMA itself should be able to direct callers who need assistance to the appropriate agency or program area automatically through voice technology systems. This will not only reduce the caller's time but will provide an added service to sister agencies and help promote a positive image of government in New York State.

Through this project, the participants became aware of the complex interaction among the various components of ORMA's information dissemination process. While at first glance the process of call completion appears to be simple, CTG's October Cost-Performance Modeling Conference provided evidence that the variety of its determinants defies intuitive understanding. Several constraints are crucial in determining the overall outcome and performance of the system. The availability of lines, ports, and operators, and the degree to which the delivery of permit information is automated, all influence the behavior of the system under different conditions. These findings are relevant to any agency seeking to use a voice processing system for dissemination of complex information.

Although the prototype proved effective in *transmitting* information to the experiment participants, analysis of the experiment's results indicated a much lower degree of accuracy and completeness of the information *received* by the participants. Much work remains to be done in exploring the factors influencing the accurate and complete reception of information disseminated by an automated voice processing system. Any agency considering such a system should take special care to address this issue.

Another avenue to be explored is the reduction of regulatory complexity and redundancy by cross-agency re-engineering. There appear to be many opportunities to coordinate multi-agency operations in areas of overlapping or complementary jurisdiction. Redesigning business regulation from the client's point of view could make the necessary processes of regulatory compliance easier and less costly.

Value to the University Community

CTG staff, faculty, and students gained experience in voice technologies, simulation modeling, experimental design, and evaluation research.

The need for future research projects is evident from the results of the experiment and the evaluation of the prototype. One such research project would investigate the comparative effectiveness of alternative means of disseminating and receiving complex information. A

comparison of current voice processing systems with systems based on paper, personal conversations, or interviews, and other interactive question-and-answer formats (kiosk-based, internet-based) would provide more information about the benefits and limitations of each type of system under varying conditions of use.

The finding that experiment participants would be willing to pay fees for enhanced services that would reduce the effort and time required to ensure complete and accurate compliance with regulatory requirements raises some interesting policy and economic issues that could be addressed in other studies. Because the experiment participants were not actually starting businesses, their willingness to pay may not be an accurate representation of such willingness among actual business creators. A survey conducted among those who are actually beginning a business would provide a better estimate of how much the agency could charge for various enhanced services. Regardless of the willingness of agency customers to pay for such services, however, there are policy issues which may affect the ability or willingness of agencies to impose such fees. An administration committed to reducing the regulatory and economic burdens on business may not be willing to impose such fees, even if the services funded by those fees may be seen as advantageous by customers.

Value to Corporate Partners

Prior to its participation in this project, Precision Systems, Inc. had not done any business with any part of New York State Government. During the course of this project, PSI obtained its first sale to a NYS agency and gained a place on the state contract system.

In addition, by participation in the public demonstration, PSI had an opportunity to gain visibility for its technological applications among state agencies. The benefit of this visibility, while still speculative with regard to higher sales, is evident in part from the many calls received by CTG from other agencies following the demonstration requesting more information on designing and implementing voice processing systems in general and on PSI in particular.

Appendix A

Timeline

Dates	Event
November 1993	Project acceptance by CTG
November 1993	Initial meeting with ORMA
February 1994	Corporate partner selected
March 1994	Facilitated planning meeting
April - August 1994	Prototype development
August 1994	Research design planning
August 1994	Prototype installed at CTG and PSI Service Bureau
August - October 1994	Prototype testing
October 1994	Cost/Performance modeling conference
October 1994 - February 1995	Analysis and modeling of current system
November 1994	Public Demonstration
December 1994 - March 1995	Evaluation
February 1995	Demonstration Follow-up Telephone Survey
May 1995	Final Report

Appendix B

Project Participants

Office for Regulatory and Management Assistance
Alfred E. Smith Building
17th Floor
PO Box 7027
Albany, NY, 12225

Susan Daniels, Associate Information Specialist
LaVina Godfrey, Manager of the Permit Assistance Section
Michael Hartigan, Supervisor of EDP
William Solis, Chief of Information Systems

Center for Technology in Government
PAC 264
State University of New York at Albany
Albany, NY, 12222

David Andersen, Director of Research Team
Peter Avery, Project Coordinator
Donna Berlin, Laboratory Manager
Mark Giguere, Graduate Assistant
Stephen Hyde, Graduate Assistant
Kristine Kelly, Research Associate
Soonhee Kim, Graduate Assistant
Michael Morris, Graduate Assistant

Precision Systems, Inc.
11800 30th Court North
St. Petersburg, FL 33716

Markus Hummel, Engineer
Robert Morrice, Vice President for Sales
Kenneth Yanicky, Sales Representative

Appendix C

Hardware and Software Architecture

The prototype system for the ORMA project was based upon Precision Systems, Incorporated's UniPort Enhanced Services Platform (ESP). The hardware components of this platform include a Node Services Manager, an Application Management System, a Voice-Media Server and an Application Creation Environment. The system supports speaker independent voice recognition and offers fax-back capabilities.

The Node Services Manager (NSM) is the call processing component of the UniPort product. It administers and executes applications deployed to the media servers and sends call routing instructions to the optional front-end switch. It can manage multiple applications, and as many as 200 different applications can execute simultaneously. If more than one call requires the same application, the NSM can execute multiple copies of the application. The NSM generates detailed call records for reporting and billing purposes. It collects system status messages for immediate reporting and monitoring to maintain optimum performance. The system collects real-time call and application statistics to provide a snapshot of current call activity on the platform. With the integration of a front-end switch, the NSM has the ability to switch a call seamlessly from one media server to another. An open, UNIX-based component based upon a Sun Microsystems, Inc. SPARC 10 workstation, the NSM can integrate state-of-the-art original equipment manufacturers' products as media servers.

The Application Management System (AMS) is a UNIX-based product that provides centralized management of the entire UniPort platform. Like the Node Services Manager, the AMS is built upon a Sun Microsystems Inc. SPARC 10 workstation. It is designed to meet the requirements of multiple and/or geographically distributed network nodes. The AMS serves as the focal point for application management and system administration. It stores all voice files, system logs, call records, and database information, and supports a centralized interface to external databases. All application management operations are performed at the AMS, including application deployment, application activation and deactivation, and application deletion. The AMS administrator controls system security and monitors activity at the NSM and media servers. The administrator can also suspend or resume call processing activities on any component. Application Creation Environments and NSMs can be dynamically added to or removed from the system.

The Precision Systems' Voice Media Server is a UNIX-based system that provides the call features of the UniPort product. It has an open architecture that supports off-the-shelf components for maximum flexibility. Each Voice-Media Server can support up to two T-1 spans or 48 channels per unit. Any channel can access any feature within the media server. Call volume and call feature capability can be expanded by adding more ports and/or media servers.

A Voice-Media Server can provide Interactive Voice Response, Speaker Independent Voice Recognition, and Text-to-Speech translation and presentation depending upon business requirements. Its flexible architecture allows a direct connection to the Public Switched Telephone Network or to an optional front-end switch. It is available in both standard and high availability models, the latter including redundant power supplies, fans and hard disk drives.

Precision Systems' Application Creation Environment (ACE) is a stand-alone development system used to create and maintain application scripts and digital voice files for the UniPort product. The ACE uses an object-oriented design with a user-friendly graphical interface. It communicates with the AMS via Ethernet or a dial-up link to receive application orders and to upload completed applications for cataloging on the AMS. The ACE markedly reduces application development time. The ACE is MS Windows-based and can be run on any 386 or better platform including laptops and notebooks, allowing for application development anytime and anywhere.

Appendix D

Related Products

Andersen, David, Peter Avery, Mark Giguere, Stephen Hyde, Kristine Kelly, Soonhee Kim, Mohammad Mojtahedzadeh, and John Rohrbaugh, "Reviewing the Performance of ORMA's Voice Response System for Automated Business Permit Information" (CTG.ORMA-010).

Andersen, David, Peter Avery, Stephen Hyde, Kristine Kelly and Soonhee Kim, "Description of and Results from the Experimental Evaluation of the ORMA Prototype" (CTG.ORMA-009).

Andersen, David and John Rohrbaugh, "Report on ORMA's Cost and Performance Modeling Conference of October 24, 1994" (CTG.ORMA-005).

Giguere, Mark, "Literature Review and Selective Annotated Bibliography" (CTG.ORMA-004).

Mojtahedzadeh, Mohammad and David Andersen, "A System Simulation of ORMA's Business Permits and Phone-Based Public Assistance Program" (CTG.ORMA-007).

Office of Regulatory and Management Assistance, "Project Proposal to Center for Technology in Government, August 16, 1993" (CTG.ORMA-001).

Appendix E

Selected Bibliography

The following reference sources related to interactive voice response systems [IVR] were compiled during a literature review conducted as part of the CTG-ORMA project. It should be noted that while there is a body of literature that discusses the more general concept of call management, there is little published material concerning IVR technology. The IVR articles that were found in the literature were most often of a case study nature and occurred in trade journals (i.e., without additional references).

Materials were selected for inclusion on the basis of (1) relevancy to research questions associated with the ORMA project, (2) relevancy to broader CTG research interests, and (3) timeliness of publication. This bibliography should not be interpreted as an exhaustive reference source, but rather a solid starting point for other projects that deal with IVR technology.

Albrecht, Karl and Lawrence J. Bradford. *The Service Advantage -- How to Identify and Fulfill Customer Needs*. Homewood, IL: Dow Jones-Irwin, 1990.

> Chapter 8 of this textbook provides information useful in the design of customer surveys. Chapter 10 provides information on the development of an automated service quality management system [SQMS] that can be used (potentially in conjunction with an IVR system) to evaluate customer satisfaction.

Birsner, E. Patricia and Ronald D. Balsey. *Practical Guide to Customer Service Management and Operations*. New York: AMACOM (A division of American Management Associations), 1982.

> Chapter 10 of this book establishes useful standards and measures that can be used to evaluate system performance. Chapter 11 establishes a formal audit procedure (which may be automated) for obtaining such information.

Borthick, Sandra L. "Through the Looking Glass: *BCR's* 1993 Readership Survey," *Business Communications Review* (May 1993): 27-32.

This 1993 survey of *BCR* readers attempts to identify key, future management and technology issues including "voice applications technology."

Brill Jr., E. Downey, et al. "MGA: A Decision Support System for Complex, Incompletely Defined Problems," *IEEE Transactions on Systems, Man, and Cybernetics* 20(4) (July/August 1990): 745-757.

This discussion of the modeling-to-generate alternatives [MGA] technique provides a potentially useful framework with which to reduce the number of potential solutions presented to a decision maker (e.g., menu choices/layers in an IVR system).

Burger, Neil A. "Burroughs Wellcome's Interactive Voice Response System Proves Itself," *Personnel Journal* (July 1990): 26-29.

This case study of an IVR system employed at Burroughs Wellcome briefly describes the capabilities of the system as well as the reason why IVR technology was chosen over an interactive video system.

Cottle, David W. *Client-Centered Service: How to Keep Them Coming Back for More.* New York: John Wiley & Sons, 1990.

Chapter 7 of this text outlines useful criteria for establishing the distinction between client-centered and resource-centered operations. In the case of ORMA and other public agencies, this is a useful exercise.

DeVigne, Jules. "Automated Telephones and Office Efficiency," *The Office* (February 1991): 28-30.

This article makes the case for implementing IVR technology as a means of improving phone communications with customers. System flexibility, voice quality, and management support are cited as crucial to the success of implemented IVR systems.

Finneran, Michael. "Revisiting the User Interface," *Business Communications Review* (July 1992): 68-70.

Although this article does not solely focus on IVR technology, portions do discuss issues associated with the development of effective IVR user interfaces.

Greengard, Samuel. "How Technology is Advancing HR," *Personnel Journal* (September 1993): 80-90.

This article focuses on the broader issues of use of information technology in the human resources management [HRM] arena. Although IVR technology is only one of the facets of IT that are examined, it does discuss the costs, advantages, and disadvantages of IVR technology in an HRM environment.

Hancock, P.A. and Joel S. Warm. "A Dynamic Model of Stress and Sustained Attention," *Human Factors* 31(5) (1989): 519-537.

This paper examines the effects of stress on sustained attention (e.g., staying in an IVR system as opposed to opting out for a human operator). References direct the reader to the copious cognitive stress literature, which might be examined for ideas related to minimizing stress in human/IVR system interactions.

Meehan, Terry. "Voice Response Application Development -- Past, Present, Future," *TeleProfessional* (April 1994): 46.

This article briefly outlines the three developmental stages of IVR technology: from multi-channel peripheral device to the current voice response-centered script applications and finally to the latest trend of graphical, icon-driven application development designs.

Miller, George A. "The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information," *The Psychological Review* 63(2) (March 1956): 81-97.

This research article is the seminal work in the psychology field delineating cognitive limits on human memory. Although dated, it is still the most frequently cited work in literature ranging from experimental psychology to cybernetics and marketing. This work establishes an upper limit on the reasonable number of items per menu level that an IVR system can expect a user to remember.

Potter, Mary C. and Linda Lombardi. "Regeneration in the Short-Term Recall of Sentences," *Journal of Memory and Language* 29 (1990): 633-654.

This paper discusses seven experiments that evaluate one's short-term memory ability to exactly reproduce a sentence (e.g., IVR system menu choices). The results indicate that immediate recall of a sentence is based on its meaning, and depends only on recently activated words (i.e., the last of the presented menu choices).

Servan-Schreiber, Emile and John R. Anderson. "Learning Artificial Grammars with Competitive Chunking," *Journal of Experimental Psychology: Learning, Memory and Cognition* 16(4) (1990): 592-608.

This experimental work, that builds on G. A. Miller's landmark study, suggests a theory that the appropriate chunking of information, based upon grammatical techniques/ constructions, may strengthen an individual's ability to successfully reproduce presented information.

Vavra, Terry G. *Aftermarketing -- How to Keep Customers for Life Through Relationship Marketing.* Homewood, IL: Business One Irwin, 1992.

While much of this book is duplicative of the other marketing monographs cited in this bibliography, Chapter 8 provides a methodology for dealing with lost customers (e.g., people who opt out of an IVR system for a human operator).

Widing II, Robert E. and W. Wayne Talarzyk. "Electronic Information Systems for Consumers: An Evaluation of Computer-Assisted Formats in Multiple Decision Environments," *Journal of Marketing Research* XXX (May 1993): 125-141.

> This review focuses on the interplay between the two major elements present in any decision environment: (1) decision strategies employed by the information customer, and (2) effects of the information (e.g., IVR) environment. An experimental design evaluates three differing computer-assisted presentation formats employed by electronic information systems.

Center for Technology in Government
University at Albany / SUNY
1535 Western Avenue
Albany, NY 12203
Phone: 518-442-3892
Fax: 518-442-3886
info@ctg.albany.edu
www.ctg.albany.edu