Chapter 6

PROFESSIONAL SERVICES TO THE FEDERAL GOVERNMENT

Table of Contents

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6.0 INTRODUCTION

As previously discussed in Chapters 1 and 5, Informatics began business by providing custom software services primarily to the U.S. federal government and secondarily, as discussed in Chapter 8, to commercial markets. (Contracts with state and local governments are discussed in Chapter 8, since the type of work and the contractual practices were more like those of private business.) Custom software services, which came to be known as "professional services," have been defined by Informatics as:

> . . . [the performance of] a variety of systems software tasks from design consulting to total implementation of large-scale information handling systems. Informatics is staffed to assume total software responsibility including such services as: function requirements specification, systems analysis, systems engineering, program design, implementation documentation, and system operation. . . .
>
> Informatics experience in applying systems software techniques has involved clients at all levels of government from municipal corporations to the U.S. Government and at all levels of business and industry from retail business operations to giant corporations and public utilities.(1)

During the company's first ten years, professional services provided the financial backbone to the corporation's success and growth. Most of Informatics revenues in its earliest years came from U.S. government contracts for the development of custom software. (In this history, subcontract work, done for commercial firms who are performing as prime contractors with the government, is considered to be "government work.") Many of these contracts permitted the company to undertake advanced development projects, several of which led to proprietary products and data services, and to enhancements of its technical expertise to enter and better serve the commercial market. During the 1970's as proprietary software products and commercial software services became an ever larger percentage of the company's business, Informatics still continued to pursue government contracts for custom software services as a major corporate objective, recognizing the importance of such contracts in supporting high technology developments and the identification of new potential products and services.

Generally, Informatics professional services to the U.S. government market evolved into three major areas of focus: defense support services, scientific inquiry support services, and programming in support of information services. The first two are discussed in this chapter; the latter is discussed in Chapter 7.

6.1 FEDERAL GOVERNMENT PROFESSIONAL SERVICES AS A CORPORATE OBJECTIVE

Upon its formation Informatics sought federal government contracts for software services both by design and default. The company's founders, having mostly come from Ramo Wooldridge Corporation and other aerospace and systems engineering companies, were most familiar with and experienced in government defense and aerospace projects. Computing technology was applied to this industry sector during the very early 1950's. It was also in this defense and aerospace sector that advanced computing technology was first applied, giving rise to the development of on-line display and real-time processing computer systems. Informatics founders had been part of this early development of computer technology, and it was their recognition of its potential commercial applications which caused them to form the company in the first place. However, their experience was almost entirely with government contracts and so by inclination the founders first turned toward the federal government for its first source of revenue. Although a parallel effort was carried on to obtain commercial work, it met with little success until about 1965.

6.1.1 Orientation Towards Department of Defense and NASA

This natural inclination toward seeking federal contracts is illustrated by Walter Bauer's first marketing plan for the company in 1962. Referring to the desirability of obtaining commercial business contracts, Bauer qualified his remarks with the statement that:

> The general orientation and knowledge of the informatics staff as it presently exists will not be readily adapted to pursuance of this business. As a longer range objective, however, this area should be examined and and sales activities begun.
>
> Data processing activities sponsored by the Department of Defense comprises a very large segment of potential work of independent software companies. The southern California area is considered to be one of the foremost areas in the country in work of this type. Also defense data processing activities give rise to more advanced systems of the type of the specialty of Informatics. It is therefore expected that a great source of sales for Informatics will be government sponsored either under direct contract to the government or, most usually, indirectly through subcontract with a government contractor. It is recognized however that it is highly desirable to have a sizeable fraction of the sales through non-federal government support channels. An appropriate fraction of the sales effort will be devoted to these areas and it is hoped that 30% of the sales could be in this nonfederal government area.(2)

Informatics "specialty" was experience with on-line and real-time systems which were just being implemented in the early 1960's in numerous Department of Defense and NASA projects and which had not yet been made available for use in the commercial business market. Thus it is not surprising that the company's first major contracts awarded in 1962 and 1963 came from the National Military Command Systems Support Center (NMCSSC), the United States Air Force's Rome Air

Development Center (RADC), the United States Navy's Office of Naval Research (ONR), and from IBM as a subcontractor at NASA's Manned Space Flight Center. Virtually all of Informatics business in its first two years came from the federal government with the majority of government revenues coming from the Department of Defense.

By 1965 Informatics had, as planned, successfully entered and made inroads into the commercial market with 36 percent of its revenues from this area. Nonetheless, 54.6 percent of its revenues derived from the Department of Defense and 9.4 percent came from subcontract work provided to NASA. Contracts with RADC (22.4 percent), ONR (10.4 percent) and NMCSSC (6.7 percent) alone accounted for almost 40 percent of the company's overall business. These contracts gave the company valuable expertise in real-time processing and on-line display systems which it later used to win and perform on large-scale commercial contracts, primarily in the area of computerized communications. Early corporate organization, as pointed out in Chapter 3, reflected this government focus. There was a separate unit for military command and control systems headed by Irving Cohen (which later reported to Eastern Operations). Informatics Western Operations including separate units for synthetic intelligence systems and NASA space flight center programming along with a third division which was devoted to contracts performed for NASA's Jet Propulsion Laboratories and Southern California based aerospace companies.(3)

As Informatics increased its share of commercial business and gradually placed greater emphasis on it, it still continued to pursue and increase the dollar volume of its government service revenues. In fact, as Informatics diversified its commercial business from professional services to proprietary products and data services, it simultaneously diversified its government business into new areas other than the Department of Defense and aerospace projects for NASA. This expansion of government services began in 1967 and primarily resulted from the company serving as a subcontractor to Univac for a communications message-switching contract for the General Services Administration (GSA) and from winning a large NASA facility operations contract. The latter led it into new technologies and increased its credibility to win government contracts outside of the Department of Defense. These brought it into the information services business discussed in Chapter 7.

The GSA contract for an advanced computerized communications system, obtained in 1965, placed Informatics directly in the communications systems market. This led to the company obtaining commercial business, performing systems design, and implementation of communications systems for Western Union, Dean Witter and Company, Columbia Broadcasting Company, Bankers Trust, a statewide law enforcement agency telecommunications network for California, and the design and implementation of an automated monetary transfer system for the Federal Reserve Bank of New York.

Prior to the height of the Vietnam war under the Johnson administration, Informatics had won large and important contracts from the Office of Naval Research. Ironically, one of the motivations for Informatics to diversify its government business outside the Department of Defense was the Vietnam war itself. Beginning in 1968, DOD funds for advanced computer systems decreased as spending for weapons for the war increased. Vietnam did generate software service projects of its own. Informatics carried on an important study in

Southeast Asia on communciations for operational intelligence and command and control. Another Vietnam related software support contract was with the U.S. Air Force. This was for the systems design and implementation of an automated defense analysis and air penetration modeling system for the Pacific Air Defense Facility (PADDAF) performed in Hawaii, Thailand and Vietnam under Don Cole as project manager.

6.1.2 De-emphasis on Department of Defense (DOD)

But competition for the massive large revenue DOD software service contracts became fierce with competitors frequently resorting to price cutting. In 1968 Werner Frank made the first mention of a drop off in DOD spending for software services, stating:

> . . . sales have fallen off, primarily because of government spending . . . [performance of Eastern Operations could have been better] if a) the government did not freeze up, b) TARMOCS, an automated defense control system for the U.S. Army had money, c) we won NMCSSC support contract. . . .(4)

It is clear from the statements made in this report that tight DOD spending or lack of funding for automated command and control systems and competition over large military support contracts was beginning to have an effect on Informatics traditional government market. In his monthly reports to the board of directors during the years of 1969 to 1971, Walter Bauer made frequent reference to the steep business decline in Eastern Operations Washington, D.C. Division, primarily dedicated to military contracts, and the drop in morale of its staff from failure to win competitive procurements. Hard hit by decreased DOD spending and intensified competion, Informatics Eastern Operations looked ahead to the growth of socially-oriented agencies that it believed would come after the war. It began to seek contracts from non-DOD agencies to offset the drop in defense business.

By 1973 one half of Informatics revenues came from the commercial market ($9.3 million compared to $9.4 million from the government sector) but only 58 percent, or $10.8 million, came from custom services as opposed to software products.(5) Despite the strong and continuing trend toward commercial business (primarily sale of proprietary products) which provided much more profit, Informatics still remained committed to custom programming for the government market as a continued objective. The position is best described by statements in the company's long-range corporate strategy for 1973:

> Custom services for the government represent an important business area for the Corporation. Historically, Informatics always has been active and strong in this market. This area of business has provided a springboard for other business facets and will continue to do so.
>
> We will continue to emphasize custom services for the government.
>
> . . . It is extremely important that Informatics remain active and grow in government data processing and information handling

areas. The Corporation is in reasonably good shape to achieve this growth because of its capability and image.

Custom services is important not only from the standpoint of continuing revenues but provides a basis upon which to develop future proprietary products and services.(6)

Nevertheless, Informatics percentage of the federal government programming services market, of significant size in the 1960's, declined to a very small fraction by the end of the 1970's. A major reason was the vision of Richard Lemons that information management (which frequently required little or no programming) was the wave of the future, as described in Chapter 7. Hence, he devoted most of his efforts to building up that area, and abdicated the company's position in programming to companies such as Computer Sciences, Planning Research Corporation, and many small local firms, which organized themselves to supply very low priced services.

Nevertheless, in the company's five year plan of 1979, Informatics restated its continuing commitment to the government market, proclaiming:

> Government professional software support services will be an area of continuing interest and emphasis in view of the significant revenues and profits its represents. It produces an excellent return on investment with zero risk.(7)

However, by 1982, the only significant programming work for the federal government was in Professional Services Operations West (PSOW) whose support contracts for NASA at Ames Aeronautical Laboratory and whose Intelligence and Military Applications Division (which had been transferred to PSOW that year) together provided annual revenues of $11.4 million.

6.2 SERVICES TO DEFENSE

Custom software services provided to the United States Department of Defense were among the first major contracts for Informatics. Due to their previous experience with the Department of Defense Damage Assessment Center (DODDAC), the founders were able to obtain, in 1963, contracts for systems design and programming services with its successor, the National Military Command Systems Support Center (NMCSSC) and with the Rome Air Development Center (RADC). These contracts led to additionaal contracts during the next ten years with the Office of Naval Research (ONR), the U.S. Navy's Pacific Missile Range (PMR), and the U.S. Air Force's Strategic Air Command (SAC) among many others. Informatics has worked on a variety of computer systems projects for the military creating annd implementing automated systems in support of communications, artillery control, missile control, sonar mapping, air attack detection and analysis, photo interpretation, and intelligence data analysis.

The majority of these projects, except efforts at PMR, were performed by Informatics Eastern Operations Washington, D.C. Division which Werner Frank established in 1963. During its first year of operation the division grew from 1 to 84 employees and continued to grow rapidly until 1969 when a slowdown in government spending was encountered. As shown in Figure 6-1, all military command and control and defense-oriented data systems are coordinated and feed

into centralized data networks for each of the major branches of the armed services and these in turn are connected and report to the NMCSSC and the Advanced Naval Military Command and Control System, both of which served the reporting, information, intelligence, and monitoring needs of the Joint Chiefs of Staff. Informatics Eastern Operations provided services to both of these higher level systems and a number of subsidiary sytems feeding into them. As revealed by the systems marked with an "X" (denoting those projects on which Informatics served) in Figure 6-1, Informatics has had experience in working in almost the entire spectrum of existing defense data systems during the period of 1962 to 1970. Most of Informatics defense projects were performed in the period prior to 1970 before Informatics placed greater emphasis on information management, proprietary projects, and services for the commercial market. A sampling of the most significant of these projects are described below.

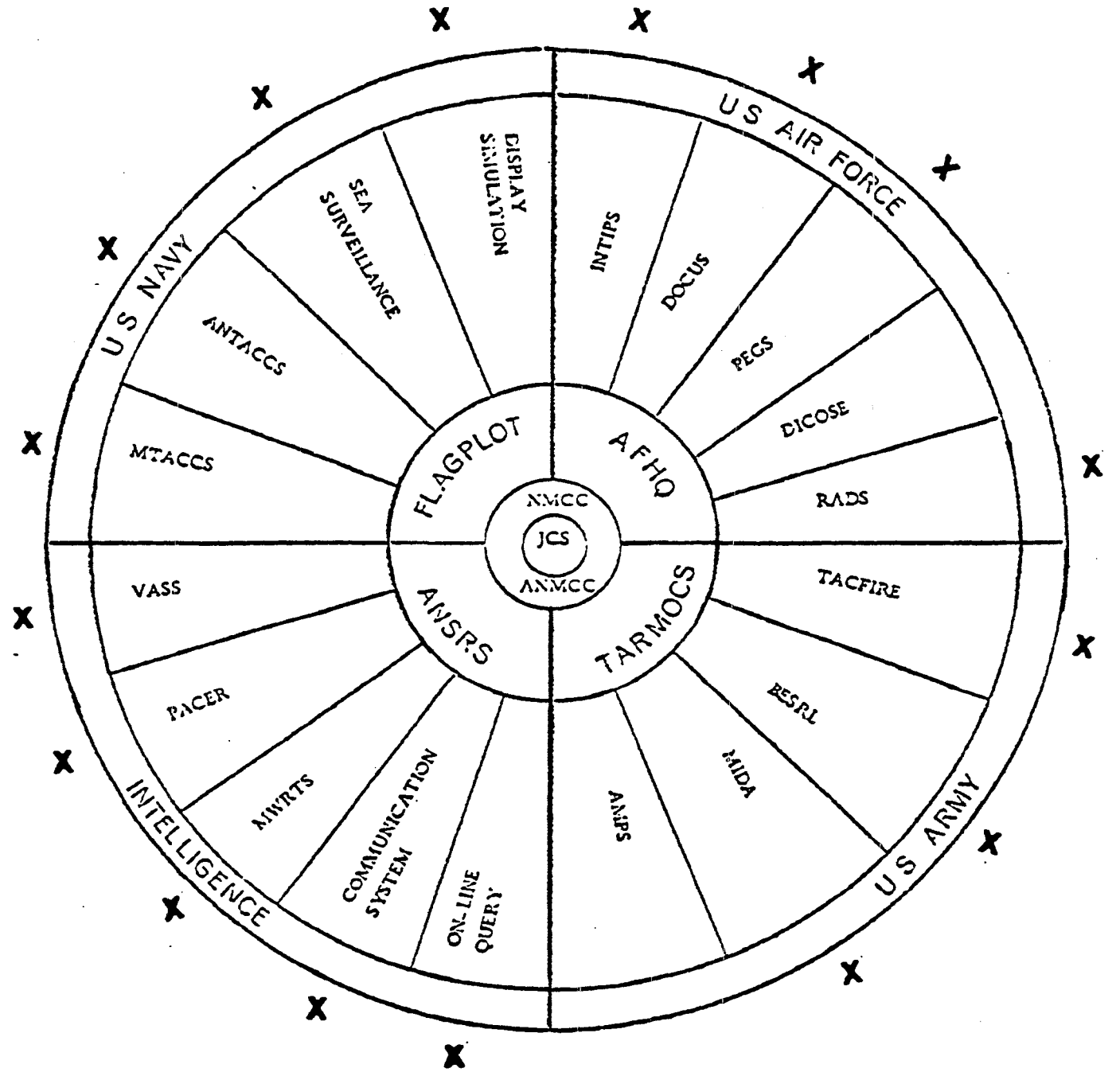
6.2.1 National Military Command Systems Support Center (NMCSSC)

NMCSSC is the top military command and control information and data processing center in the United States reporting directly to the Joint Chiefs of Staff, the Secretary of Defense and the President of the United States. All other military control and intelligence systems interface with and feed into the NMCSSC. Under the auspices of the Defense Intelligence Agency, Informatics obtained a systems support contract, originally for $222,550 with NMCCSC in March 1963 due to prior work experience of its founders with the center's precursor, DODDAC. DODDAC had been established in the 1950's to monitor potential damage and available national resources in the event of an nuclear attack on the United States. During the early 1960's, DODDAC's mission was expanded to control and monitor all high level data and intelligence gathering and reporting for the combined armed forces, and it was renamed NMCSSC.

At NMCSSC, Informatics personnel, under the direction of Werner Frank, performed software systems design and development of an on-line display query and retrieval system using Bunker Ramo BR-85 display terminals, among the first display terminals developed, connected to CDC 1604B and 160 computers. Informatics was responsible for writing executive control programs for the display system. This was one of the first on-line display systems, and it was to be installed merely on an experimental basis within the existing NMCSSC information system which was based on punch card input and printer output. Informatics software was so successful that the entire system soon became directly controlled by the display terminal only, with all data and data base queries entered directly by the BR-85 operator. Informatics succeeded in obtaining follow-on contracts with NMCCSC for extension of the display system, a requirements study and an exercise production system. The company performed continously for NMCCSC until March 1968, recording a total of $1,594,104 in revenues from these projects.(8)

6.2.2 Rome Air Development Center (RADC)

Informatics has continously provided systems design and programming services to RADC since 1963. RADC is the primary technical development and experimental project base for operational and intelligence computer systems for the United States Air Force. Informatics has served on numerous advanced and highly classified projects at RADC during its early years including the Display Oriented Compiler Usage System (DOCUS), the Integrated Image Processing System



Note: X = Informatics Involvement

MILITARY SYSTEMS WHICH INVOLVE

INFORMATICS SOFTWARE SERVICES

Source: Technical Presentations by Informatics Inc. Custom Divisions, 1969

FIGURE 6-1

(INTIPS), ECP2, SATAN, a Visual Analysis Subsystem (VASS), and a portable Mobile Wing Rapid Response Time System (MWRTS). Most of these projects involved advanced software systems design for automation of intelligence photo interpretation, multi-computer data systems and experimental airborne rapid deployment data systems. Most of the RADC contracts were won and implemented by California personnel under Richard Kaylor, reporting to Frank Wagner, with the indispensible help of Werner Frank. When Kaylor relocated to New York to establish Northeast Operations, all of them were transferred to Informatics Eastern Operations Washington, D.C. under Werner Frank which established field offices in Rome, New York, reporting to Kaylor.

An interesting aspect of RADC work was their use (exclusive to them, in Informatics experience) of imaginative "fixed price term" contracts. Such a contract was performed for a fixed price, and required the delivery of specified items. But it also provided that the work would be done by performing a specified number of labor hours of various labor classifications. The contracting officer had the option of requiring the delivery of either the specified items or the specified labor hours, or some combination of both. Thus, if the work, which was usually of an advanced research nature, needed re-direction, it was easy for RADC to effectively change the contract to a "labor-hours" type by waiving the delivery of the specified items, and using the specified labor hours on their new requirements. In this way, as long as Informatics work was pleasing to the customer, much of the financial risk of fixed price contracts was avoided, while the possibility of high profits was not excluded as it would be in cost plus fixed fee contracts.

6.2.2.1 Typical Early Projects for RADC

As previously described in Section 5.3.2, DOCUS provided "a software system which demonstrates a methodology for computer users to solve day-to-day problems in an on-line environment." This was an early on-line applications development project, performed for $615,000, that permitted users to program applications involving CRT displays by compiling various programs at a display console. Werner Frank conceived the idea and designed the system. Informatics created general purpose software for this project. It was essentially hardware independent and flexible enough that users could extend or modify the program without recourse to professional programmers. The experience gained on DOCUS permitted Informatics Eastern Operations to develop DISPLAYALL (years before its time--see Section 11.5.1 as a proprietary software product.

INTIPS was performed for the Information Processing Center of RADC and involved the design and implementation of an executive control program for a multicomputer, which had unique advanced computer architecture, a "polymorphic" diversified input-output, operating environment. This system brought together the then "divergent concepts of multiprogramming and multicomputers" by attempting "for the first time . . . to separate those functions of executive control which are dependent upon specific equipment from those which are not functions of the executive, but designed in anticipation of possible changes or additions to the current equipment configuration,"--even dynamically. Herbert Bright served as Informatics project manager for INTIPS.

ECP2 was another advanced executive control program which sought "to provide for evolutionary incorporation of devices more suited for the task with no

disruption of the existing software systems." An original effort to develop transportable software among different kinds and even future unspecified computer hardware, ECP2 found use in an integrated multicomputer complex involving three computers, two buffer modules, magnetic drums and tape drives, display consoles, a printer and a hard disc drive.

SATAN was an automated syntax analysis system for a program language designed for use on the CDC 1604B computer. It produced object code from selected source programming languages, permitting identification of syntax variations among different computer languages, and allowed systems programmers to extend existing assembly languages and to define new ones. Directed by Al Goodman as project manager, SATAN gave informatics market entry for a number of other assembly language programming contracts at RADC.

The Visual Analysis Subsystem (VASS), performed under subcontract to Bunker-Ramo for the Strategic Air Command, provided an on-line file maintenance, information retrieval and graphic analysis of intelligence data utilizing Univac 1219 computers and BR-90 display consoles. The system permitted users to use English language terms as commands and to update and store displays at will. Roy Bigelow served as Informatics project manager for VASS which was a fixed price contract for $194,650.

MWRTS was among the most interesting and futuristic of Informatics projects performed for RADC. Directed by Marvin Howard as project manager, it involved the development of a rapid response portable field data system for airborne deployment. This was a large-scale computer center which could be quickly set up in the field, using air transportable modules for housing, in support of reconnaissance activities and photo intelligence interpretation. MWRTS was a fixed price contract, performed for $238,219, and represented the beginning of automation of field photo interpretation by the military.(9)

The Program Assisted Console Evaluation and Review System (PACER) was Informatics first programming support contract with the U.S. Air Force's Strategic Air Command (SAC). A fixed price level of effort contract for $2 million, it was obtained in 1966 with RADC serving as the procurement agency for SAC. The contract was to design and develop the programs for a visual analysis subsystem to provide information retrieval and maintenance of on-line displays used for strategic intelligence data. The acronym PACER was invented by Informatics, connoting that the system "paced" or led the analyst through the solution of his problems at increasing speed.

PACER addressed the need for effective processing of a rapidly growing volume of photo intelligence material by a limited force of trained personnel. It was an on-line data manipulation system which "significantly" increased "the quality and quantity of work produced by intelligence analysts vis-a-vis their work in a manual data storage environment. Utilizing a computer-based data base and display consoles (involving a General Electric 635 computer and 16 BR-90 display terminals), the system aided photo interpreters and intelligence analysts in correlating with previous holdings the most recent intelligence received.

Besides the programming, Informatics contributions to PACER included development of recommendations for the general system configuration, separation

of intelligence applications programming efforts from hardware systems programming efforts, creation of the PACER Programming Language (PPL)--a powerful COBOL language derivative--to simplify applications programming by intelligence personnel, selection of systems algorithms which permitted batch jobs to be run simultaneously with on-line processing, training of system users, systems test and evaluation, and design and implementation of a data base structure. The technology developed by Informatics made PACER a success and made it the "acknowledged prototype for modern computer-based systems supporting exploitation of intelligence materials." With continued updating, the software system, later renamed SOLARS (SAC On-Line Analysis and Retrieval System), was still operational in 1982. This technology is applicable to many other fields where complex data needs to be manipulated in a real time environment.(10)

The RADC projects described above were initially obtained prior to 1966. Between then and 1970 Informatics continued to perform services on a number of other smaller scale but similar related projects. These included standard systems test software for automated photo interpretation activities (Project TIPI), a cartographic test software system, a defense intelligence communications software system (DICOSE), software for an airborne central data tape recorder (ACDTR), a JOVIAL language compiler program, and an automatic program segmentation system. Projects begun in the 1970's and 1980's are described in the next section.(11)

6.2.2.2 Typical Later Projects for RADC

RADC handled the procurement for various highly classified projects, usually involving intelligence data, for the Air Force operating commands. As a result of the reputation gained on the above projects, especially PACER, Informatics was awarded several long-term R&D contracts. For SAC, at Offutt Air Force Base in Omaha, Nebraska, Informatics has served as a subcontractor to Planning Research Corporation (directed to be such by RADC) from 1966 through 1982, developing many classified systems. At the ADCOM (Aerospace Defense Command) under Cheyenne Mountain near Colorado Springs, Colorado, it has filled a similar role from 1972 through 1982, as subcontractor to INCO. In Washington it provided, from 1969 through 1982, support to COINS (Community On-Line Intelligence System), a major classified communications system. Informatics has also played a leading role from 1980 through 1982 in developing and installing software for CUBIC (Common User's Baseline for the Intelligence Community), the only worldwide computer communications system certified by the Department of Defense as secure enough to transmit the most sensitive intelligence data. Other major contracts in recent years are in support of the Defense Intelligence Agency, the U.S. Air Force Intelligence and Warnings System, the U.S. Readiness Command, and the USAFE Tactical Air Intelligence System. All of these projects were carried on by the Intelligence and Military Applications Division under George Ashenfelder. As might be deduced from the applications being worked on, personnel in this division must have security clearances at a very high level. In 1982 this division was transferred to Professional Services Operations West, reporting to Paul Connolly.(12)

6.2.3 Pacific Missile Range Real Time Data Handling System

In 1963 Informatics Western Operations obtained a contract from the Office of Naval Research to develop the programming systems for a very sophisticated

multicomputer radar detection real time data handling system for the U.S. Navy's Pacific Missile Range (PMR) located in Pt. Mugu, California. Robert Reinarts, under Richard Hill, served as manager for this project which involved the systems design of a computerized radar instrumentation control system for testing naval missiles. The system encompassed coordinated input and processing of real time data from ten radar tracking stations located along the California coast to permit the acquisition of missiles, automatic aircraft vectoring, mathematical analysis of trajectories and re-entry phenomena. The real time data processing system would be used by PMR to direct practice fire against attacking air or space vehicles. Equipment used on the project included Univac CP642B and 1218 computers.(13)

6.2.4 Advanced Naval Tactical Command and Control System (ANTACCS)

Informatics served on a very important and interesting command and control systems project for the U.S. Navy. This project was ANTACCS, a future oriented requirements study to determine the necessary technology and equipment required by Naval commanders for the ten years between 1970 and 1980. The project was discovered by Werner Frank. Because of the close relationship that he developed with the project director in ONR (including working with him right through the Christmas holidays), Informatics Eastern Operations was able to develop more competence on the subject than any of its competitors. Walter Bauer described the project with the following statement in 1964:

> The present ANTACCS efforts are oriented toward developing comprehensive background information for the future Naval Tactical Command and Control Systems. It is aimed at providing a compendium of information for systems planners. The technology which will be investigated will be basic and across-the-board. Special emphasis will be given to typical shipboard problems. Efforts toward a systems plan will be limited to candidate approaches to system implementation. The entire effort is oriented principally to the Task Force Commander.(14)

Bauer decided that the work was important enough to warrant an organization dedicated to it, and hired Irving Cohen as vice president/Command and Control Systems to be project manager, reporting directly to the President. The contract for the project was awarded by the Office of Naval Research (ONR) and included two phases (phase I for the study of available and future technology and naval requirements; phase II to develop an implementation plan and installation schedule) for a total firm fixed contract price of $1,118,421, out of which with Informatics earned $85,106 in profits or 8.3 percent. During the course of the project, Informatics personnel including Werner Frank interviewed naval personnel and actually spent time on cruise with the Navy to determine its future needs and requirements for an advanced data processing organization, man/machine interface systems, attack readiness assurance systems, and necessary command and control software. Final delivery of the ANTACCS report was made in June 1967.(15)

6.2.5 Marine Tactical Command and Control System (MTACCS)

Due to its work on ANTACCS, Informatics obtained an extension of the contract through the Office of Naval Research in 1965 for the performance of the

systems requirement study and development of a systems concept for the United States Marine Corps. Although similar to ANTACCS, MTACCS was a more detailed study focused on the automated command and control systems needs of the Marine Corps for the period between 1975 and 1985. As described by Bauer:

> The technology of MTACCS, for example, will be extended to cover in more detail the special environmental and transportability problems of a command and control system which is projected ashore.
>
> Whereas in the present ANTACCS System we will limit the effort to candidate approaches to system implementation, with MTACCS a system concept will be developed. In other words, the efforts will carry significantly further toward a system design. Furthermore, the efforts will be oriented to the system in direct support of the shore-based commander.(16)

MTACCS was a fixed price contract performed for $397,185 in revenues and a profit of $32,795. Project personnel, all of whom had worked on ANTACCS, included Irving Cohen as project manager, David Burdett, Knight Campbell, John Saxbe, Richard Young, James Parham, and George Arnovick. During the two year project which ended December 31, 1966, Informatics personnel explored computer technologies for mobile land combat, projected future input-output technologies, display technologies and communications systems, and designed a system for use in mobile and amphibious assault operations.(17)

6.2.6 Behavioral Science Research Laboratory (BSRL)

Among the work performed for the United States Army by Informatics was systems design and analysis services for the Army's Behavioral Science Research Laboratory in support of automated on-line display devices, response modules, and viewing stations connected to a CDC 3300 general-purpose computer. It was used to record and retrieve multi-sensor reconnaissance imagery data for intelligence photo interpretation activities. The laboratory conducted experimental studies of the photo interpretation processes and surveillance imagery analysis procedures to maximize the information extracted from reconnaissance data "in terms of accuracy, completeness and speed." Informatics specific tasks for the laboratory were the integration of the computer into the surveillance system, the design and implementation of an executive control program, and the development of a number of individual programs to assist computer-mediated experiments. Much of the work was ergonomic in nature, concentrating on creating efficient and productive workstations and systems for photo interpreters to use, employing automated systems for experimental psychologists who had little or no computer experience. The majority of these projects were managed by Mary Ann Savas and Steven Stofko of Informatics Eastern Operations Washington, D.C. Division.(18)

6.2.7 The TACFIRE Project

In 1968 Informatics won a subcontract with Litton Data Systems to design and implement software for a tactical fire direction system for use by the U.S. Army. An advanced weapons project, TACFIRE gave field commnanders a means of expediting decisions in planning and executing artillery missions with its specific objectives described as:

> . . . to increase the effectiveness of artillery fire support through increased accuracy, reduced reaction time, and greater efficiency in determining fire support capabilities. The system will be implemented at the batallion and division artillery echelons and will provide back-up support to functions of Corps artillery. TACFIRE operational functions include Ammunition and Fire Unit Status, Artillery Fire Planning, Artillery Target Intelligence, Field Survey Support and Fire Control. At the division and corps level, additional capability will include Nuclear Target Analysis, Chemical Target Analysis and Nuclear Fire Planning. The TACFIRE equipment is designed to function under any terrain or climate conditions that may be encountered by the field army. It is also capable of being operated from vehicle carriers, caves, basements, or other locations found in the field.(19)

The system provided both intelligence and message processing using both digital and voice communications. TACFIRE was also unique in that it "integrated the most advanced microelectronic computer, communication, display equipment and modular software." The system made use of one of the first prototype microcomputers, manufactured by Litton, as a portable data system mounted within mobile artillery vehicles.

TACFIRE was the "first total package procurement contract to be awarded by the Army" and one of the largest contracts awarded to Litton up to that time. As subcontractor to Litton, Informatics was awarded a number of contracts, including three large ones. One of these was a time and materials contract for $250,000 for design and development of an operating system including executive, loader, job control and input/output programs. The second was a fixed price effort for $492,000 to provide programming aids and a system exercisor and training evaluator.(20) The third was a compiler for TACPOL which stood for "TACFIRE Programmer-Oriented Langage." Informatics managed the project, but retained Abacus Inc. as a subcontractor for the basic design and much of the development of the compiler. It was a special-purpose JOVIAL compiler, designed for applications program development for the U.S. Army's TACFIRE computer system. In addition to the design of the language dialect and the coding of the compiler, Informatics was responsible for preparing systems test and acceptance programs. This was a firm fixed price contract of approximately $335,000. These two firm fixed price programs under the project management of Roy Bigelow produced very large profits. Indeed, says Frank Wagner, they may have been the only firm fixed price contracts to deliver tested programs on which Informatics ever produced more than its planned profit.

6.2.8 Pacific Air Defense Analysis Facility (PADAF)

As a result of its successful performance on PACER, Informatics was able to obtain a number of fixed price and level of effort contracts from the United States Air Force's Pacific Air Defense Analysis Facility (PADAF) in Hawaii for a total price of $2,690,000. PADAF is responsible for defensive threat study and analysis maintaining an "all-source" data base on selected subjects and providing target materials for tactical units and summary analyses for command units. Under the direction of George Stock, one of the company's earliest

employees, Informatics performed systems design and analysis, programming and implementation of an on-line display terminal system used to store and retrieve various intelligence data. As part of its work in developing the data base, Informatics engaged in a large-scale study of intelligence information flow throughout the various military echelons in Southeast Asia. This included visiting various Air Force units and interviewing military personnel located in Thailand and Vietnam.(21)

6.2.9 General Instrument Project Honey

Between 1963 and 1966, Informatics served as a subcontractor to General Instrument Corporation on its contract with the Office of Naval Research for the systems design and development of the software for a sonar array subsystem known as Project Honey. The purpose of the system was to provide oceanographic mapping in support of Polaris submarine missle programming. Using a military version of the TRW 130 computer connected to a large-array sonar transmitter, the system produced accurate maps of the ocean bottom. Informatics provided real time executive programming, development of diagnostics programs for all special purpose equipment, preparation of program documentation, and consulting to the U.S. Navy during collection operations in the Northwest Facific. William Moore, Informatics project manager (not to be confused with Bill Moore of RADC, who became for a short time in 1970 Informatics vice president in Washington, D.C.) made many voyages in support of the system after it was installed on shipboard.(22)

6.3 PROFESSIONAL SERVICES IN SUPPORT OF SCIENTIFIC INQUIRY

Informatics first began providing custom software services to the scientific community in its first year when Werner Frank, with an occasional assistant, performed numerical analysis and programming on several small contracts with high technology companies in the Los Angeles area. A major leap forward occurred in 1963 when the company obtained a subcontract from IBM Federal Systems Division to provide programming support to NASA's Johnson Space Center in Houston, Texas. The vast majority of Informatics programming services to the scientific community have been in direct or indirect support of NASA projects for space flight and exploration research. Within Informatics Information Services (formerly Systems and Service Company and Informatics TISCO) a sizeable proportion of its business has been in support of NASA libraries and technical documentation centers, especially NASA's Scientific and Technical Information Facility. Almost all of its information services technology resulted from this one contract alone. Because the NASA STIF effort led Informatics into new markets and proprietary information services, this particular effort is discussed in Chapter 7, Information Services.

Informatics other custom services to NASA have been in the realm of programming support services contracts lasting several years. Most of these were provided by Informatics Western Operations during the 1960's and later by Professional Services Operations Western Division after the company acquired Programming Methods, Inc. in 1975.

6.3.1 IBM Federal Systems Division, NASA/Houston

In May 1963 Informatics obtained its first sizeable programming support contract ($250,000) from IBM Federal Systems Division to serve as a subcontractor in support of IBM's programming efforts for the Mission Control Center, popularly known as the Real Time Computing Center (RTCC), at NASA's Johnson Space Center at Clear Lake, Texas, usually refereed to as NASA/Houston. The Gemini Space Flight program was under development, and IBM found itself short of qualified programming personnel capable of supporting the project. It therefore planned to subcontract parts of its programming responsibilities to two independent software companies.

IBM Federal Systems Division headquarters in Bethesda, Maryland, conducted a competition, issuing a Request for Proposals to all qualified independent software companies, stating that it would employ two companies to suply 25 programmers. Frank Wagner obtained this contract for Informatics by using his personal association with Howard Bedford, IBM's project manager in Houston, to determine the exact type of personnel that IBM needed for the project. He then made a nationwide recruiting trip to attract qualified programmers and systems analysts. Wagner persuaded them to sign employment letters of acceptance, contingent upon Informatics obtaining a contract with IBM by painting a glowing picture of the advantages of participating with Informatics in this new glamorous, advanced project. He then submitted a proposal consisting primarily of the letters of acceptance and resumes of these contingent employees. IBM awarded a time and materials support contract to Informatics to supply 13 people. The contract to supply the remainder of this need was awarded to Computer Applications, Inc. (CAI). Informatics, due to Wagner's prior recruitment efforts, was able to place most of its people on the job within a month, much faster than CAI. The result was that IBM soon terminated CAI and extended the scope of the contract with Informatics to supply the complete requirement for contract programmers. IBM renewed the contract in March 1964 for an additional $300,000. Informatics eventually supplied a staff of 30 programmers, including Billy Joe Bates and Claude Creswell, who became long-time employees.(23)

At the RTCC Informatics supported IBM in projects for the control of Gemini space missions and later for the upcoming Apollo space program. In addition to the operations control software, simulation programs amd system support programs were prepared by the company. These projects involved utilization of a multicomputer hardware configuration of five IBM 7094 model II computers for Gemini and five 360/75's for Apollo, with each set of computers sharing a common executive control system. Informatics project managers stationed at IBM Houston included Roy Bigelow, Robert Castanias, and Norman Woodfield.(24)

6.3.2 Jet Propulsion Laboratory (JPL)

JPL is a laboratory for the development and operation of unmanned space vehicles and their on-board experiments, operated for NASA by the California Institute of Technology. Late in its first year of its existence Informatics won its first firm fixed price contract from JPL for $23,000. It was to supply an executive control program for a coupled pair of SDS 920 and 910 computers which controlled the deep space antenna at Goldstone in the Mojave desert. The

project floundered until Robert Heckathorne took it over and completed it, breaking even with the help of a $7,000 change of scope. But soon thereafter, Informatics lost the competition to Computer Sciences Corporation (CSC) for a much larger programming support contract at the main laboratory site in Pasadena, California.

This hurt; however, as Walter Bauer said, "It's our kind of work," and he vowed to replace CSC when its three-year contract expired. The vow was fulfilled, and the recompetition of the contract was won due to the reputation of Dr. Robert Rector whom Informatics specifically hired in March 1965 from Ramo Wooldridge as vice president of Western Operations Aerospace Division, reporting to Frank Wagner, to direct the JPL support efforts.

Informatics began to supply 10 to 15 people per year, providing programming support services to JPL under a three-year cost plus fixed fee contract for about $1 million. The contract was later increased to 33 people for annual revenues of about $1.5 million by early 1967. Informatics was then the largest of four contractors providing software services to JPL. In 1969 JPL decided to contract its these programming support services on a sole source basis--essentially a facilities management contract--and awarded the contract to Informatics.(25)

At JPL in Pasadena Informatics personnel provided systems analysis and programming services in support of all major projects, including the Viking, Mariner Mars, Pioneer F, and Surveyor space missions. Its activities aided research efforts involving astrodynamics, control systems theory, communications systems analysis and numerical analysis. Informatics created programs to process solar wind spectometer data from lunar instruments contained on Apollo 12, simulate moon landings for Surveyor spacecraft, and perform pre-flight system checkout for the 1969 Mariner Mars and Viking satellite flights. It developed the DSN (Deep Space Network) program to provide real-time simulation of the operations of three deep space probes and two orbiting spacecraft concurrently, to aid in training for Mariner Mars and Pioneer F, and to transmit commands to and interpret telemetry data from all Pioneer F missions and future unmanned space flight missions. This latter program, known as TCD, "was designed to be as mission-independent as possible, to permit wide usage for all present and anticipated space programs." It allowed Pioneer F, exploring the solar system beyond the orbit of Mars, to transmit scientific information back to earth concerning the interplanetary medium, asteroid belt, and Jupiter and its environment. The major programming support contract was lost on price to Telos in about 1975, but was replaced by a somewhat smaller contract, which was still active in 1982, to operate the Digital Image Processing Laboratory. Under it, Informatics employees produced all of the photographs of the planets recorded and transmitted by JPL's deep space exploration vehicles.(26)

6.3.3 NASA/Ames Research Center

Informatics has provided programming and systems design support services continously since 1967 to NASA's Ames Research Center, located in Palo Alto, California. Initially, the contract provided for a competition for the award of each task, against several competitors, including Computer Sciences Corporation, System Development Corporation, and Programming Methods, Inc. In this environment the staff was built up to about 30 people. Later, a basic support

contract was awarded. The company's position there was solidified when Informatics acquired Programming Methods, Inc. and merged PMI's professional services operations with that of its Western Systems Company, all under Paul Connolly.

The Ames Research Center performs research in the fields of aeronautics, space and life sciences. At the center, Informatics personnel have developed programs to support automated systems to measure magnetic field data transmitted to earth from the Explorer and Pioneer satellite and Apollo space missions, operate plasma probes abroad the Pioneer satellites, perform ionosphere experiments on the Alouette and Isis satellite space flights, process air pollution data from U-2 flights over San Francisco, collect and process data for the world's largest complex of wind tunnels (located at Ames) used for research in aerodynamics, and provide computerized control of airborne 36 inch telescopes. On the latter project, Informatics personnel fly the missions in the large aircraft in order to support the software while the experiments are conducted. As a result, there has never been an experiment failure or a mission aborted due to software malfunction. These contracts are on a cost plus award basis, and Informatics has consistently received very high awards for its performance.(27)

It was at the Ames Research Center that Informatics became involved in the biggest government contract challenge it ever experienced and set a first in government software procurement history. As discussed in Section 2.1.13, NASA sought competitive bids for a sole-source contract to supply programming services to the Ames Research Center. This competition resulted in part from the recent merger of Informatics and PMI, the two companies which, along with Computer Sciences Corporation (CSC), had traditionally performed software services for Ames during the prior decade. The fiercely contested procurement narrowed down to a competition between Informatics and CSC. NASA awarded the contract rather suddenly and without explanation to CSC. It then issued an abrupt 30 day notice of termination of contract to Informatics.

This circumstance appeared rather suspicious to Paul Connolly, vice president of Informatics Professional Services Operations West, who was unable to obtain consistent information from NASA as to why CSC was selected. Dissatisfied with the response to his inquiries, Connolly had his division file an official protest with NASA and the General Accounting Office (GAO)--the government agency in charge of policing the federal government's procurement practices, arguing that Computer Sciences could not have won the contract strictly on a performance basis, since Informatics had always received such high award fees. Costs for the two competitors would have been very close. Tension and hostility erupted among NASA, Informatics, and CSC. Nonetheless, Informatics temporarily retained its contract while GAO examined the procurement procedure used by NASA.

In the meantime Connolly initiated a private investigation of his own. This effort soon discovered that CSC, in response to formal queries from NASA as to how it would staff the contract, had claimed that Informatics employees assigned to Ames, with whom it claimed to have made contact, were disgruntled with their present employer and would be willing to join CSC if NASA granted it the contract. Upon this revelation, Connolly proposed to GAO that a private law firm be designated to take depositions from the employees involved (with

Informatics offering to pay the resulting legal fees). GAO refused this offer but did send its own investigators to privately question the Informatics personnel supposedly contacted by CSC. Waiting until GAO concluded its investigation, Informatics then questioned the same employees and discovered that no contact with them had ever been made by personnel or representatives of CSC.

Realizing that its findings were the same as that of GAO's, Informatics suggested to NASA that it reconvene procurement discussions and disqualify the CSC proposal for making fraudulent statements. NASA (embarrassed that their largest services contractor was accused of fraud) rebuffed this suggestion claiming that the final GAO report had not been issued. Since the release of the report could take months, Connolly began a publicity campaign against CSC and its competitive practices, personally contacting California congressmen to present Informatics case. This lobbying effort eventually resulted in NASA being embarrassingly questioned about the Ames Research Center procurement during congressional budget hearings during 1978. By this time GAO released its report that found CSC had made false representations and that several CSC employees, involved in the proposal effort, had confessed to making the fraudulent claims. Fifty weeks after its procurement selection, NASA relented to pressure, nullified its previous decision, and awarded the contract to Informatics.

Successful government procurement protests are very few in number, and Informatics victory was the first large-scale procurement protest won against NASA. In 1982 Informatics had 214 people assigned to projects at the Ames Research Center earning over $10 million in annual revenues. But another important result of the NASA protest was that it taught Informatics that it should actively exercise its rights as a corporate citizen in fighting for government business. Several times before in its past, most notably with a procurement proposal to the National Library of Medicine for the MEDLARS program, Informatics had submitted the lowest bid but the contract was awarded to another contractor.

> On the MEDLARS procurement Informatics had submitted the lowest bid, but government purchasing agents mistakenly added the company's quoted overhead rates twice with the result of a higher figure. Informatics discovered this mistake soon after the contract was awarded to Computer Sciences. The National Library of Medicine refused to reconsider its award, and Informatics did not file a formal protest.

In one instance, the company was asked to withdraw, for undisclosed reasons, an unsolicited proposal to NMCSSC for a potential project (very useful to NMCSSC) which had it identified <u>on its own</u>. The agency awarded the exact same task a few months later to a competitor on a sole source basis.

> In the fall of 1969, we were working very hard to get follow-on business at NMCSSC. . . . After some months had elapsed after submission of the NIPS proposal, we were called in [to a high military officer's] office . . . with a strange cloak-and-dagger type request.

> [He] asked us to withdraw our proposal. He said he couldn't make us do it and stated that if anything official were ever asked of him in the future, he would of course deny that he had ever formally asked us to or caused us to withdraw the proposal. Because we hoped to get more business from the Support Center, we meekly withdrew the proposal. . . .
>
> Quite obviously, the Support Center wished to give the contract to IBM and couldn't with our lower priced proposal in their hands. Their solution was to get us to withdraw ours and then they could feel free to contract with IBM.

In these competitive procurements Informatics heeded decisions of government officials as final and gracefully accepted the loss rather than antagonize the customer. However, after the 1978 protest, Informatics shifted its posture towards government procurements and initiated protests when the situation merited it. This was particularly true in 1980 when Informatics lost in a competition for renewal of its long held support contract for NASA's Scientific and Technical Information Facility. While its protest for this procurement did not succeed, Informatics was retained to supply services for one year longer than would otherwise be the case and earned an additional year's profits from the project.(28)

6.4 OTHER FEDERAL PROFESSIONAL SERVICES

As discussed at the beginning of this chapter, during the 1960's the nature of Informatics custom programming efforts was oriented towards high technology. Consequently, for federal customers the areas in which it was active were primarily applications and systems programming in support of military, intelligence, and scientific users.

In the 1970's other federal customers, primarily socially-oriented agencies, were aggressively cultivated. The work for these customers became primarily that of information services in which custom programming played an important but secondary role. This work is important enough to deserve a separate chapter and is described in Chapter 7.

However, there have been a number of projects for other agencies of the federal government. A few of the more important ones are described here.

6.4.1 State Department Automated Inquiry System

In 1965 Informatics Eastern Operations acquired a fixed price contract for $174,000 with the United States Department of State to provide software systems design and development for an automated on-line inquiry system for the verification and control of passports and visas. This system consisted of an international communications network, with terminals located in various cities within the United States, Mexico, and Canada, which provided prompt access to a large central data base of passport and visa applicant files. Julian Adler was the project manager. The successful installation of this system permitted foreign-service personnel to instantly verify passport and visa status of U.S. citizens abroad and of alien residents in the United States.(29)

6.4.2 General Services Administration/Advanced Record System

Informatics entered the communications systems market in 1965 when it was awarded a firm fixed price subcontract from Univac for the software that Univac was under contract to supply, for communications computers, to the prime contractor, Western Union. The system was for the General Services Administration of the United States Government to provide a large-scale computerized communications system to store and forward messages. This contract was performed by Informatics Eastern Operations Washington, D.C. Division and was known as the Advanced Record System (ARS). It was a nationwide message-switching system for use by the civilian agencies of the U.S. Government. It involved three switching centers to perform the store-and-forward functions, and 400 communications terminal stations on a teletype network serving 600 cities in the continental United States. The system accommodated a diversity of communications devices and terminals and was interconnected with the Department of Defense's CONUS AUTODIN, American Telephone and Telegraphs's TWX, Western Union's Telex, and other public message systems. The ARS system was responsible not just for forwarding messages to respective destinations but also had to determine the proper responder to incoming messages and verify that required communications systems events occurred within various time constraints.

This was technically a very difficult programming systems design and implementation contract for Informatics. It fell behind schedule and encountered malfunctions in the Univac 418 computer on which the system was based. In addition, Informatics suffered all the problems of a third-tier subcontractor, without access to the prime contractor or the customer. Nonetheless, Informatics succcessfully completed the project for Univac, but earned only a small amount of profit even after several increases in price due to changes in scope. In the long run, however, the project turned out to be significant to Informatics because it gave the company technical expertise and experience in communications systems and led to additional, more profitable computerized communications projects and to the development of the ICS IV/500 communications system (described in Section 11.6.2).(30)

6.4.3 Department of Housing and Urban Development (HUD)-- Management Information Systems

This was a very major project for the development of business data processing applications within HUD, involving two firm fixed price contracts aggregating about $1.5 million. It was the first significant system development and programming task in business data processing undertaken for the federal government by the Washngton, D.C. Division. The first contract began in early 1969 and the second in 1970. The work was finally brought to a conclusion in the summer of 1972. The projects were a disaster for both HUD and Informatics. A federal government report, published several years later, lists 15 instances of procurement by the federal government of large computer program development which failed; the HUD project was one of these. That report castigates federal government procurement practices, pointing out that everything that could be done wrong by the government on the projects was done wrong. It concludes that in all 15 cases it was impossible for the contractor to achieve the objectives intended due to the incompetence of the government. On the HUD project, however, Informatics was far from blameless, and the losses sustained were probably just retribution for the errors in underestimating the complexity of the project, poor technical performance, and inept contract administration.

The largest system was the Integrated Personnel and Payroll System (IPPS) for approximately 16,000 HUD personnel in headquarters and regional offices. Other systems were for accounnting and operational control of all of the many housing projects which HUD was administering. The new systems were to replace existing manual systems and a large number of small, fragmented obsolescing systems running on a small Univac 1106 computer at HUD. As a part of the contract, HUD requested that Informatics retain the Washington, D.C. office of Arthur Young & Company (certified public accountants) to insure that the accounting aspects of the systems were satisfactory.

With the advice of legal counsel, Wagner presented to HUD all of the reasons why the failure was HUD's fault, and why HUD was responsible for vastly increased costs. He stated that Informatics would defend itself under the legal doctrine that HUD had created a situation where it was "commercially impossible to perform" under the contract. His implied threat was that public legal proceedings before a board of contract appeals would bring to light all of the incompetence that HUD had displayed. This tactic had the desired effect on HUD officials, whose careers would be blighted by such publicity. Wagner then orally acknowledged that Informatics should share part of the blame and suggested a termination "for the convenience of the government," with a somewhat reduced contract price which would cause Informatics to sustain losses proportional to its degree of fault.

After two months of sparring, Wagner and HUD came to a negotiated agreement. HUD would accept all of the work done to date on the IPPS and some of the work on the other systems. Informatics would complete work on some systems. The total price was reduced by $67,500. Wagner then negotiated a settlement with Arthur Young & Company (for their contribution to the problem) for a reduction of $45,000 in their price to Informatics.

Through the rest of 1971 and early 1972, Informatics attempted to fulfill this latter commitment. This time Informatics did a good job and completed the programs by December 1971. But further difficulties arose. The bad feelings between Informatics and HUD personnel, expecially the in-house computing organization who had to run the acceptance tests, resulted in further disputes. The lack of any specified objective acceptance criteria in the original contract, and HUD's subsequent refusal to approve any, had returned to haunt both parties. HUD proposed termination with a reduction in contract price of $137,000. In June of 1972 another settlement was negotiated. HUD accepted all the work already completed for a reduction in contract price of $64,500, and both parties wearily walked away from the disaster.

The total financial loss to Informatics was less than $200,000, spread over two years. It showed the folly of trying to do large programming development contracts, which are basically R&D (research and development) projects, for a firm fixed price. It was probably as a result of this unfortunate experience that Informatics thereafter shied away from seeking contract programming work with the federal government in the area of administrative data processing.

6.4.4 U.S. Air Force Logistics Data Base Systems

As discussed in Chapter 8, programming for administrative data processing (commonly called "business data processing" whether or not it was for a "business") was never a strength of operations in the West until 1975. However, after the acquisition of PMI which had such competence, Professional Services Operations West (PSOW) developed a cadre of expert consultants for IMS, IBM's data base management system (DBMS), and tried to build a business in IMS consulting and education.

In 1978 PSOW obtained a contract from the U.S. Air Force Logistics Command, located at Wright Patterson Air Force Base in Dayton, Ohio. It was a $50,000 firm fixed price consulting study to review the IMS data base operating on a triplex IBM 360/67 computer in a data center at Tinker Air Force Base in Oklahoma. (Interestingly enough, the data was fed into IMS from an IBM 7080, which was the successor hardware for the system initially installed by John Postley, as mentioned in Section 2.1.5.) The study included determining the cost of converting to other manufacturers' hardware or to new IBM hardware and/or a DBMS other than IMS, and assessing the data base design of the new Comprehensive Engine Maintenance System (CEMS) then under development. The study was very successful, and a year later Informatics was awarded another firm fixed price contract for $100,000. This project involved the specification of a dependent processor to link logistics analysts with CEMS and to review and refine the CEMS data base design. The work was primarily done for Tinker but also involved bases in Missouri, Virginia, and Texas. The recommendations were to procure an IBM 4341 processor and to make changes to the data base design.

As an outcome of this study, in 1980 the company won another contract at Tinker Air Force Base to help develop the CEMS system for a new, modern computer. This project, involving 54 COBOL/IMS programs, took several years, and recorded over $1 million in revenues. Because of this successful performance, another contract was awarded for design of a new spares system (then running on the 7080) for the new hardware. PSOW recommended the use of MARK V and, when it was actually used, there were savings of 50 to 60 percent in development time.(31)

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