REPORT OF SURVEY CONDUCTED AT

UNISYS CORPORATION

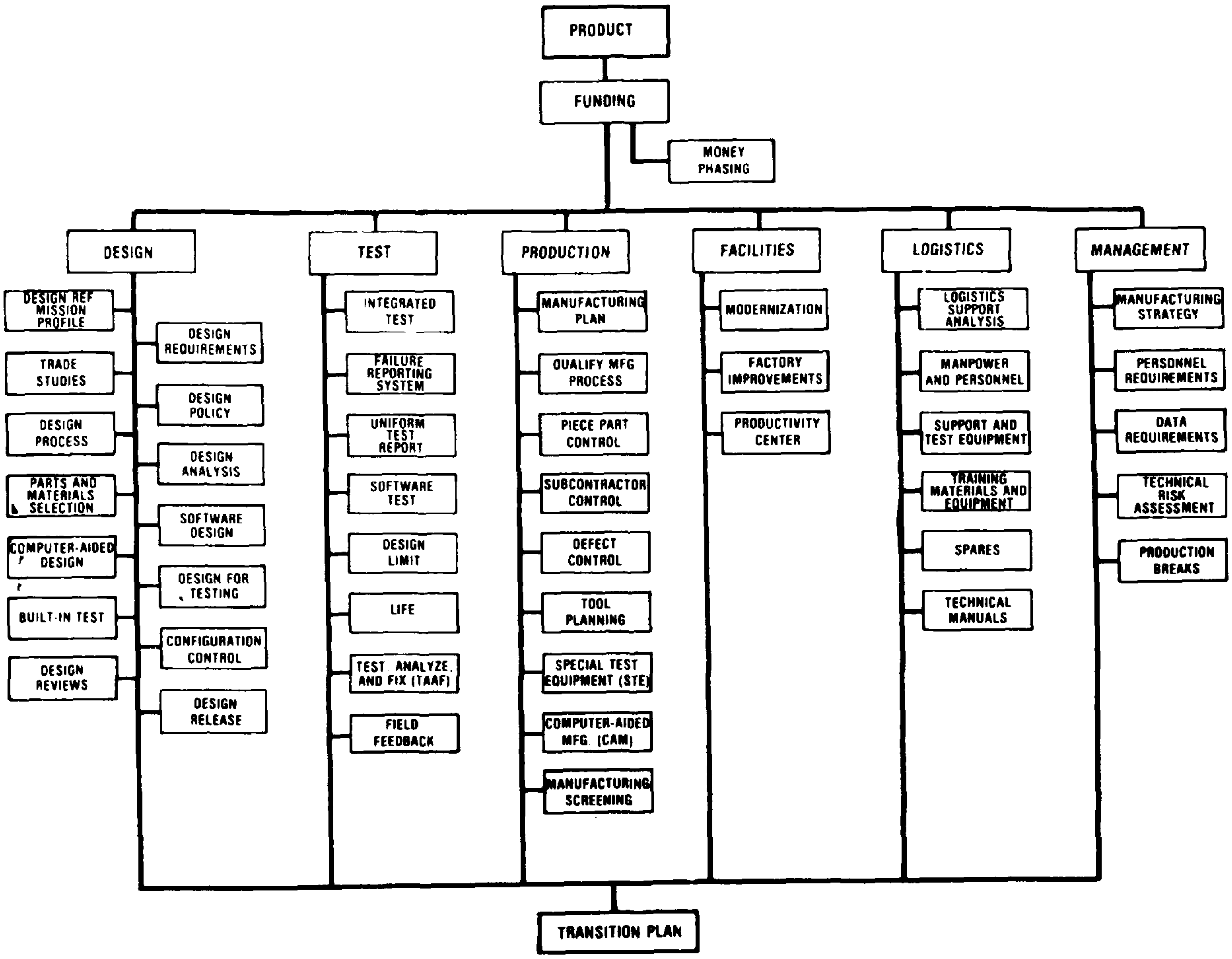
COMPUTER SYSTEMS DIVISION

ST. PAUL, MINNESOTA

NOVEMBER 1987

DoD 4245.7-M, "TRANSITION FROM DEVELOPMENT TO PRODUCTION"

CRITICAL PATH TEMPLATES



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The purpose of the Best Manufacturing Practices (BMP) survey conducted at this facility was to identify their best practices, review manufacturing problems, and document the results. The intent is to extend the use of progressive management techniques as well as high technology equipment and processes throughout the U.S. industrial base. The actual exchange of detailed data will be between contractors at their discretion. A company point of contact is listed in the report

The intent of the BMP program is to use this documentation as the initial step in a voluntary technology sharing process among the industry.

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C O N T E N T S

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SECTION 1

INTRODUCTION

1.1 SCOPE

The purpose of the Best Manufacturing Practices (BMP) review conducted at UNISYS Corporation, Computer Systems Division (CSD) was to identify best practices, review manufacturing problems, and document the results. The intent is to extend the use of high technology equipment and processes throughout industry. The ultimate goal is to strengthen the U.S. industrial base, solve manufacturing problems, improve quality and reliability, and reduce the cost of defense systems.

To accomplish this, a team of DoD engineers reviewed UNISYS CSD in St. Paul, MN to identify the most advanced manufacturing processes and techniques used in that facility. Manufacturing problems that had the potential of being industry wide problems were also reviewed and documented for further investigation in future BMP reviews. Demonstrated industry wide problems are submitted to the Navy's Electronics Manufacturing Productivity Facility (EMPF) for investigation and resolution.

The review was conducted on 16-20 November 1987 by a team of DoD personnel identified on page 2 of this report. UNISYS CSD is primarily engaged in design, development, production, and integration of strategic and tactical information systems and products.

The results of BMP reviews are being entered into a data base to track best practices and manufacturing problems. The information gathered will be available for dissemination through an easily accessible central computer. The actual exchange of detailed data will be between contractors at their discretion.

The results of this review should not be used to rate UNISYS CSD among other defense electronics contractors. A contractor's willingness to participate in the BMP program and the results of a survey have no bearing on one contractor's performance over another's. The documentation in this report and other BMP reports is not intended to be all inclusive of a contractor's best practices or problems. Only selected non-proprietary practices are reviewed and documented by the BMP survey team.

1.2 REVIEW PROCESS

This review was performed under the general survey guidelines established by the Department of the Navy. The review concentrated on the functional areas of design, test, production, facilities, logistics, management, and transition planning. The team evaluated UNISYS CSD's policy, practices, and strategy in these areas. Furthermore, individual practices reviewed were categorized as they relate to the critical path templates of the DoD 4245.7-M "Transition From Development To Production." UNISYS CSD identified potential best practices and potential industry wide problems. These practices and problems and other areas of interest identified were discussed, reviewed, and documented for dissemination throughout the U.S. industrial base.

The format for this survey consisted of formal briefings and discussions on best practices and problems. Time was spent on the factory floor reviewing practices, processes, and equipment. In-depth discussions were conducted to better understand and document the practices and problems identified.

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SECTION 2

BEST PRACTICES

The practices listed in this section are those identified by the BMP survey team as having the potential of being among the best in the electronics industry.

2.1 DESIGN

DESIGN PROCESS

In-Depth Analysis of Design Process

UNISYS CSD has documented with flow charts an in-depth analysis of the design process. The analysis tracks functional elements from pre-award to manufacturing release. It provides them with a clear understanding of the impact of each design element on successful product development. Significant effort is now being directed at assuring that the design process is properly addressing producibility, design analysis, review, and release. Company policies, procedures and practices now more accurately reflect accountability and integration of critical elements with the total development process. This clear understanding of the design process provides a stronger producibility decision making capability for such issues as organizational changes, professional resource requirements, and prioritization of capital expenditures for engineering tools. UNISYS CSD has also begun to establish criteria to evaluate the effectiveness of knowledgeable workers and provide a productivity measurement.

Design Process

The design process is initiated with a planning phase which serves to establish scheduling, staffing, design rules, and cost management techniques. Once the planning phase is complete, preliminary design is initiated. In this phase, functional block diagrams are developed in accordance with design requirements and hardware partitioning is completed. Preliminary packaging concepts are developed and software/firmware sizing and analysis are completed. The preliminary design phase is terminated with a specification compliance review. The detailed design phase involves electrical, packaging, and software design tasks. A detailed electrical design is undertaken and results in schematic generation and various design assessment analyses. Packaging design develops as piece parts are designed, and fabrication drawings are generated along with assembly drawings. Software coding and program assembly are undertaken. The next phase includes fabrication and assembly of an Engineering Design Module (EDM) to be used in the integration and test phase. The integration and test phase includes hardware/software integration and the performance of design verification tests. The design process concludes with a full range of environmental tests to qualify the design for military use. The design process includes the extensive use of CAE tools and techniques to analyze the design as it evolves, with the objective of minimizing the need for fabrication and assembly of hardware for design verification.

COMPUTER-AIDED DESIGN

CAE Organization

A recognition of the fact that extensive simulation using CAE techniques to speed the development process and reduce costs has been made by engineering management. Simulation is seen as necessary to achieve single pass on component and printed wiring board designs as well as to reduce the number of design iterations to reach production.

Management has also recognized that engineering is quickly moving from being a labor intensive operation to being a capital intensive operation. This is significant because productivity enhancement of engineering groups may rely on management's understanding of this fact and their willingness to budget funds for this change.

DESIGN REQUIREMENTS

Project Plan

UNISYS CSD requires that every project have a written project plan. The contents of these plans are peculiar to each project. The plan includes the methodology to validate requirements, a description of the design approach, the methodology of design verification, task completion criteria, test methodology, and task management techniques. Formal reviews are scheduled early in the project to ensure that interface and functional requirements are adequately defined. A particularly effective feature of the project plan is the method it uses to assure the requirements are understandable, accurate, and completely documented. Lists, checklists, outlines, cross-reference indexes, standard forms, multi-tiered schedules, and concise computerized reports are used to simplify the complex assortment of information which needs to be generated and become available to all project personnel. The project plan truly enhances the design process. Rather than burdening the designers with time consuming tasks, these forms (1) enhance the design process with definitive job assignments and simplified reporting assignments and (2) ensure conformance with design requirements.

DESIGN POLICY

Design Standards

A very complete set of project management guides and design standards exists to aid the project engineer and designers in the development process. Aspects covered include establishing support and maintenance concepts early in the design phase, assuring that the development team acquires an adequate understanding of how the equipment being developed is to be used.

One particularly noteworthy practice is the establishment of design completion criteria. These criteria aid in making the decision of when to shut the development process off and transition to production.

DESIGN FOR TESTING

Factory Testable Designs

Engineering management has a high commitment to field and factory testable designs. Testability and BIT requirements are identified early in the project so that test resources can be allocated at the same time as functional resources. Testability and Built-In Test BIT are part of all internal peer reviews as well as formal preliminary and critical design reviews. Regularly scheduled integrated diagnostics meetings are held which include representatives from all design areas and manufacturing. Standardized test and maintenance buses are used to simplify interfacing to automatic test equipment. Factory and field testability is enhanced by allocating Built-In Self Test (BIST) at the chip, module, and equipment level. This allocation of BIST techniques at all Logical Reconfigurable Unit (LRU) levels provides a firm foundation for a system test hierarchy. Fault modeling and simulation using ZYCAD assures accurate assessment of BIT capability.

Design for Test

A highly visible commitment has been made by management to assure testability of all equipment designed. Company policy includes the requirement that factory test procedures be established prior to full scale development. Programmer/maintenance stations for automatic test equipment are designed concurrently with prime equipment. Testibility is also a part of internal design reviews and formal PDRs and CDRs.

CONFIGURATION CONTROL

Configuration Management

A highly automated and efficient Configuration Management (CM) system has been implemented and consistently demonstrated on previous contracts. Detailed standard practices have been prepared and are updated semiannually. The automated CM information systems are of particular interest since they integrate all the CM systems (active change status, product definition, configuration base, automated data control, field configuration status, and executive reporting). Successful implementation of these systems is due in large part to the company's recognition that professionally skilled personnel (engineers, mathematicians, and computer scientists) are required to develop/maintain these systems. These professionals comprise approximately one-half of the CM staff. A career ladder has been established to attract and retain configuration management specialists.

2.2 TEST

INTEGRATED TEST

Automated Test System

The Automated Test System (ATS) is a system designed to automatically perform various final/complete product tests which normally require a dedicated test technician to spend many, long, tedious hours for set up, monitor, and control. ATS uses six DEC computers each supporting up to 35 test stations (210 total test stations) to configure and control electrical test under environmental conditions. Technician generated standard software (AUTOTEC) controls test sequences while actual performance/functional testing is controlled by software/firmware that is unique to the product under test.

ATS offers several other distinct advantages over manual test methods. Auto logging of test failures and test registers at time of failure (Electronic Log), auto generation of failure reports and data, and auto search of the Electronic Log for similar failures on previous tests are just a few of these advantages.

The large capacity of ATS insures maximum product throughput while the high degree of automation insures thoroughness and repeatability of all test program requirements. The standardized software and test system hardware only requires that the product specific software/firmware and a product adapter be developed to add new product test capability to ATS.

FAILURE REPORTING SYSTEM

Failure Reporting Analysis and Corrective Action System

The Failure Reporting Analysis and Corrective Action System (FRACAS) is used to determine failure modes that impact product reliability. Failure reporting is performed to obtain quantitative/qualitative data at the piece part level, subassembly level, module/computer system level, and at the field level. Failure analysis is performed to determine the failure cause and the necessary corrective action prior to initial program input. FRACAS problem areas are that failed items are not returned (thrown away) and there is incomplete documentation on returned items

DESIGN LIMIT

Environmental Test Laboratory

An environmental test laboratory is used to support design verification, first article, and production sample testing. The climatic portion of the laboratory has several temperature/humidity chambers, a temperature/altitude chamber, and a corrosion chamber for salt fog tests. The mechanical portion of the laboratory contains a wide variety of equipment to perform vibration, shock, inclination, enclosure, and packaging testing. The EMI portion of the laboratory consists of a primary shield room with an auxiliary room for instrumentation, which contains two automated EMI measurement systems. There is access to other environmental test equipment owned by other companies that complement these capabilities. Because of their expertise and capability in environmental testing, UNISYS CSD often performs the required testing of subcontractor material.

2.3 PRODUCTION

QUALIFY MANUFACTURING PROCESS

Rigid-Flex Printing Wiring Cables

About 300 rigid-flex cables per week are being produced in over 87 different designs. The designs contain 2 and 3 flex layers and in the rigid areas up to 12 layers. The designs attach to both card and round connectors, and up to 240 pins and 155 pins respectively. The cables are 1 inch wide and up to 45 inches long with 10 thousandths of an inch lines and spaces. The maximum rigid section thickness is .080 inch with hole aspect ratios up to 3.5. The drilled holes are 100% inspected and plated with a sulfate copper process. The plated copper holes are "pretinned" using a 60/40 solder plate process. This level of process sophistication has been used for nearly 5 years. The overall yield is about 75%.

A specially designed copper plating process appears to give an improved, uniform, hole plate thickness by applying a consistent current density to the board.

Standard Electronic Module Fabrication

In the last 3-4 years, ceramic circuit card production has undergone significant process improvements by industry. The UNISYS CSD Shepard Road facility is currently producing 1700 ceramic circuit cards per month in up to 100 different part numbers. Class 10,000 clean room facilities with temperature and humidity controls are used. Firing furnaces have special construction to contribute to product uniformity and most handling is from magazine to magazine to eliminate operator handling. The equipment unloads and loads the magazine after performing its operation. The facility is run on a 3 shift per day basis. The yield is greater than 95% at "second pass" inspection. The top and edges are sealed with amorphorus glass at the completion of the fabrication cycle. While some aspects have been in operation since 1982, the current level of sophistication has been on-line for about one year.

Subassembly Test

Subassembly test includes both in-circuit testing of components and functional testing of electronic circuit card assemblies. In-circuit testing verifies that previously tested components have not been damaged through handling of the manufacturing process. Functional testing verifies that the unit was built and functions within design specifications.

Two innovative, in-house developed functional test capabilities add significantly to optimum utilization of high cost ATE systems and highly skilled technical personnel. These capabilities are the Test Engineering Graphics (TEG) and the Expert Guided Probe (EGP).

The TEG system is a significant move toward a paperless factory. TEG presents schematic tracing assistance to the ATE test technicians by means of computer generated graphics on a 19" display terminal. The TEG presents colorized annotations on ACCA schematic diagrams showing "should be" signal conditions (high-low-off) and gives traceability of how the troubleshooting reached the current point in the schematic and where that path should logically proceed. A voice activated technician to TEG interface allows the technician total use of his or her hands for troubleshooting.

The EGP provides the troubleshooting knowledge and expertise of the most highly skilled test technicians in the form of a computerized expert system. Thus, the skills of the average skilled technician are greatly enhanced while highly skilled technicians have a fall back technician consultant to give them technical troubleshooting consistency from day to day. EGP looks at the bad outputs and guides the technician to probable input conditions which could possibly cause the bad output, thereby eventually isolating the problem to a faulty component. EGP uses existing CAD topology and test program files to identify failing circuit nodes and then analyzes logic levels for each appropriate circuit point throughout the test sequence.

Just In Time Manufacturing

Just In Time (JIT) manufacturing has been implemented at the UNISYS CSD site in Pueblo, CO. The Pueblo facility, before the implementation of JIT, was having significant problems in manufacturing the AN/AYK-14 Standard Airborne Computer within schedule and cost guidelines. Traditional methods such as increased overtime and manpower were unsuccessful. Having determined that JIT could be a possible solution, a balanced JIT manufacturing line was designed after engineer and technician training. Within two months, the build time was reduced from 38 days to 12 days, defects were reduced from 60 per unit to 12 per unit, and the technician headcount was reduced from 15 to 8. After further refinements, the JIT manufacturing line had increased productivity by 50% and decreased the cost of the AN/AYK-14 by 25%. Varying production volumes hamper full implementation of JIT due to the required rebalancing of the manufacturing line. Implementation of JIT throughout the Computer Systems Division is a major ongoing intitiative.

PIECE PART CONTROL

Consolidating Procurement, Receipt, Inspection, Staging, and Distribution of Material

Consolidating procurement, receipt, incoming inspection, parts storage, kitting, and distribution of material is being performed by the Material Management Center (MMC) facility in Pueblo, CO. This facility supports three manufacturing functions at St. Paul, MN; Clearwater, FL; and Pueblo, CO. By consolidating efforts at one facility, UNISYS CSD has minimized inventories, reduced lead times, and improved productivity via automation.

The MMC facility is a paperless material handling system, which includes bar coding and laser tracking of parts on receiving, automated storage and picking, and engineered staging and inspection workstations.

The MMC facility is designed to process up to 1,000 receivings a day, pick and kit over 10,000 items, and ship up to 600 fully inspected jobs to the three manufacturing sites.

The MMC facility has implemented a program of computer-aided inspection. One aspect is to generate test software off-line to the test equipment. Off-line generation allows the test equipment to be used exclusively for incoming inspection and writing of software by the technical staff. Inspection procedures are also computer generated and are based on a library of standard attributes. These attributes are then selected and arranged to generate a procedure, which is readily updated and rearranged when needed. The status of inspection is fed to the communications network of the MMC as well as the three assembly plants.

Product quality by vendor and part number plus type and quantity of defects are tracked from initial receiving and inspection throughout production fabrication of assemblies. Failure Reporting Analysis and Corrective Action System (FRACAS) information is passed from the production line back to the MMC facility for updating vendor performance reports.

DEFECT CONTROL

Quality

The principal elements of the Quality System are Statistical Process Control (SPC), Oregon Matrix, and Quality Improvement Process (QIP). A computerized SPC system was developed to provide management visibility on workmanship, process trends, and areas of improvement. The SPC system collects the data into a file which contains the necessary information to calculate the daily average number of defects, the preceding thirty daily averages, and the upper control limit. When out of control conditions exist, the cause is identified and corrective action is taken. The Oregon Matrix is used to integrate process control and other criteria into an overall productivity index.

The Quality Improvement Process encourages quality improvements, measures the cost to do the job wrong and right, identifies system error (cause removal and corrective action), and sets goals to be accomplished. The Quality Improvement Team was established to improve the process of problem elimination. Management is the prime supporter of the program and is aware of those who perform outstanding acts to meet goals. Savings and goals are auditable from reports, charts, SPC, and Oregon Matrix.

COMPUTER-AIDED MANUFACTURING

Data Network Manufacturing

The backbone of the Computer Integrated Manufacturing (CIM) program is a computer-aided manufacturing data network. The network provides the link between manufacturing automation areas and the engineering databases. UNISYS CSD approached the development of the network from physical, logical, and common software architecture aspects. The physical aspect of the network consists of two Sperry 1100 mainframe computers linked to a factory machine interface by a DECNET network. The logical aspect of the network is to extract data from the engineering databases and convert it to manufacturing instructions. The manufacturing instructions are then downloaded to the appropriate people/machines. The most significant aspect of the network was the approach to developing a common parent routine that provides modular interconnection and internal logging functions. The standardized conventions and message formats greatly facilitate development and maintenance. The current network supports fully automated capabilities for PC fabrication final level production, automated drilling, continuity test and wire wrap assembly, integrated surface mount technology, and a paperless shop floor control system. The use of this software architecture greatly enhances the capability to interface new machines to the network.

2.4 FACILITIES

MODERNIZATION

Surface Mount Technology Center

A stated objective is to focus expertise and capital resources to become a "world class" producer of Surface Mount Technology for the DoD. To achieve this objective, a center will be established in Pueblo, CO that will build upon the capabilities of the Material Management Center (MMC). The best available PC manufacturing and test experts will be relocated to Pueblo from other sites.

The center which is expected to be operational in 2-3 years, will develop the next generation of PC assemblies. The SMT center will utilize the MMC automation backbone to directly feed assembly workstations. The intent is to eliminate kitting, shipping, and material handling, and to build upon the Standard Electronic Module Card Assembly and Processing System (SEMCAPS) and the Circuit Card Assembly and Processing System (CCAPS) development.

2.5 MANAGEMENT

MANUFACTURING STRATEGY

Manufacturing Strategic Plan

A Manufacturing Strategic Plan has been implemented that is innovative and effective. Their corporate mission is to be a low-cost, high-quality producer, utilizing the full resources of the facilities at St. Paul, MN; Clearwater, FL; Pueblo, CO; and Winnepeg, Canada. The Manufacturing Strategic Plan that is in-place is structured to accomplish that mission. The Manufacturing Strategic Plan is orchestrated from the St. Paul facility, coordinating activities at the other locations. Example: a centralized master schedule for a twelve month period is developed and maintained at St. Paul for each location; a three month "window" of that master schedule is maintained at each location, being updated continuously on a "rolling wave" concept. Through this master schedule, the needs are implemented at each location according to the specialties of each location. The specialties of each location are:

Development/prototyping	St. Paul
Material management	Pueblo
PC/ceramic fabrication	St. Paul
SMT (production)	Pueblo
Full MIL manufacturing	Clearwater and Pueblo
Low-cost down-load	Winnepeg

This plan is beneficial in that it offers local, centralized control over multi-sites and eliminates duplication of effort at each site. It also identifies the specialized efforts at each site and type efforts are assigned to those sites accordingly. The implementation of this plan is, by its structure, a cost reduction tool.

PERSONNEL REQUIREMENTS

Suggestion and Recognition Program

Most progressive, employee conscious corporations realize that their employees constitute an outstanding source of knowledge and information that can be beneficial to the corporation and use various types of employee suggestion programs to obtain that information. In addition to a suggestion program, UNISYS CSD has a suggestion and recognition program, which consists of two distinctly different programs, the Employee Suggestion Program and the Achievement Award System. Although similar in some ways, the two are different. In each program, however, the award incentive is monetary. The Achievement Award Program is a three part plan which consists of: short term achievement awards, a plan which gives almost immediate recognition; invention awards, a progressive plan which encourages employee inventors; achievement awards for excellence, a quarterly evaluation plan which can award larger sums of money than the other two.

Training

A comprehensive training program is in place at UNISYS CSD. This program includes an initiative to comply with DOD-2000 training and certification requirements. Another effort involves a statistical process control program for engineers and supervisors, as well as an abbreviated version for hourly rated employees.

Program management training is offered, which is based on DoD 4245.7-M. This training package provides familiarization with the technical issues of design, test, and production.

DATA REQUIREMENTS

Cost Management System

An ambitious study is under way to determine an effective alternative to the classic costing models that are based on an allocation of overhead costs as a function of direct labor cost.

The study was necessitated by the introduction of manufacturing automation and the resultant reduction in direct labor. The cost accounting systems in use today were built upon direct labor standards as a basis for collecting and distributing costs. These accounting systems are approaching obsolescence in today's environment where computer time, depreciation, and other fixed costs have a much higher impact on total costs to the customer than production labor.

The approach that is being investigated will assign these costs to the area where it is incurred and controlled. The system will collect costs at the cell level as they are incurred, without allocation. Relevant data will be available on a timely basis. UNISYS CSD feels that such a system will improve cost visibility; i.e., those cells or product lines that are actually responsible for incurring such cost as computer time and depreciation will be charged with those costs. This should provide a powerful incentive for managers to control such costs. It will also force them to make tradeoff studies before they arbitrarily incur overhead type costs.

The planned implementation date for this reporting system is January 1989, although DCAS approval has not yet been obtained.

By way of comparison, the Shepard Road plant today tracks 15% of controllable costs to the cell level. Under the proposed system, 53% of the controllable costs would be tracked to the cell level.

2.6 TRANSITION PLAN

Transition of Product Engineering Responsibility

UNISYS CSD's Manufacturing Engineering function is unique in its organizational implementation. Personnel with manufacturing experience are involved in the earliest phases of conceptual design. These manufacturing personnel influence the design to make the item fit local manufacturing standards, to simplify the manufacturing process, and to achieve design to cost goals. The feature of this system which is unique is the transition of product engineering responsibility to the manufacturing department at the start of production. Product engineering has full responsibility for change control of the data package.

The transition process begins with the transfer of individuals from the design team in the engineering department to the manufacturing department. The transfer of personnel from the design team assures that detail knowledge of the design and the rationale for design decisions are present in the product engineering group.

There are a number of advantages to locating the product engineering functions in the manufacturing department. The cultural influence of being in the manufacturing department is important. The emphasis on solving production problems and the reduction in finger pointing would be a natural by-product of this organization. The resolution of problems between those responsible for fabrication and those charged with product engineering would also be simplified by the reduced number of management layers. Other likely benefits of the organizational structure are:

Better use of existing manufacturing resources
Less learning in production
Improved quality and reliability
Reduced unit production cost

Manufacturing Engineering Group

In May of 1987, a Manufacturing Engineering Group was created to perform producibility studies and develop a design to cost system. The group pulls engineers and production people from various organizations to form Manufacturing Engineering Teams. The teams are assembled and become members of the Project Engineering Teams at project inception. Primary benefits these teams provide include: (1) smooth transition from design to production; (2) improved producibility, quality, and reliability; and (3) incorporation of manufacturing cost as design criteria.

SECTION 3

PROBLEMS

The practices listed in this section were identified by UNISYS CSD to the BMP survey team as being potential electronics industry wide problems.

3.1 LOGISTICS

LOGISTICS SUPPORT ANALYSIS

Schedule Compression Resulting From Streamlined Acquisition

UNISYS CSD feels that the increased emphasis on compressed delivery schedules places a burden on the logistics support function and creates strains in the Logistics Support Analysis (LSA) process.

Essentially, the problem is that LSA cannot be performed effectively before product design is finalized. Yet, final configuration support requirements are a deliverable along with the initial production hardware. This problem has been briefed to the BMP team previously. It appears to be an industry-wide problem that needs to be addressed.

3.2 TRANSITION PLAN

Manufacturing Engineering

An uexpected problem has been encountered in implementing the Manufacturing Engineering Group activities toward establishing a good transition from design to manufacturing. Some resistance/criticism has been experienced coming from the local DCAS structure. It has been suggested by CSD that DCAS should be made aware of, or made to understand, the philosophies and intents contained in DoD 4245.7-M as the contractors attempt to implement them. A lack of understanding by DCAS causes unnecessary delays in the implementation of the "templates." It is further suggested that any DCAS/4245.7-M orientation be done on a national organizational level in order to eliminate duplication of problems as contractors involve out-of-state sites, i.e., CSD St. Paul to CSD Clearwater.

SECTION 4

SUMMARY

Many best practices were identified by the BMP survey team at UNISYS, CSD. Among the most outstanding were the Material Management Center (MMC) in Pueblo, CO and the manufacturing strategic plan to utilize the specific resources of each facility. With development and prototyping being done at St. Paul while material management and production are being performed at the other facilities, understanding and executing the transition process becomes paramount.

The MMC provides a centralized function, supporting the three manufacturing locations. Procurement, receipt, inspection, staging, and distribution is performed in a highly automated "paperless" environment. Additionally, Just In Time manufacturing concepts have been successfully employed on the AYK-14 Standard Airborne Computer.

Considerable work has been done in the production of ceramic circuit cards. Further advancement in this area is being accomplished through the work in the Navy Manufacturing Technology Program sponsored project, Circuit Card Assembly and Processing System (CCAPS).

The point of contact for this BMP survey is:

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His cooperation, time, and quality of effort in preparation and hosting of this survey at UNISYS CSD and participation in the Best Manufacturing Practices Program is greatly appreciated.