Multimedia Superabrasive, Laser Cladding, and Waterjet
Technology Performance Support System

Federal Manufacturing & Technologies

Maribeth C. Bohley and

Tom J. Ciccateri

KCP-613-6025

Published April 1998

Final Report/Project Accomplishments Summary

CRADA Number 96KCP1031

Approved for public release; distribution is unlimited.

Prepared Under Contract Number DE-ACO4-76-DP00613 for the
United States Department of Energy

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AlliedSignal Inc.

Federal Manufacturing
& Technologies

P. O. Box 419159

Kansas City, Missouri

A prime contractor with the United States

Department of Energy under Contract Number

DE-ACO4-76-DP00613.

64141-6159

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Distribution Category UC-706

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Date: 9/15/97

Revision: 0

A. Parties

The project is a relationship between

AlliedSignal FM&T

Huffman Corporation

2000 E 95th Street

1050 Huffman Way

PO Box 419159

Clover, SC 29710

Kansas City, MO 64141-6159

B. Background

Huffman Corporation provides manufacturing process solutions incorporating user friendly CNC, multi-axis, precise, durable, flexible, compact and safe Grinder, Laser, and Waterjet systems. Huffman has identified a market need for a method of delivering specialized information to machine tool operators and technicians in support of manufacturing, delivery setup, and operations. The market need is being generated by the increasing levels of complexity involved in the selection, assembly, calibration, and operation of these high-precision machine tools. This need was also identified in the 1995 Preliminary AMT Roadmap. What is this?

Performance requirements demand expert knowledge of a growing number of technologies and subsystems' operations. Quality concerns dictate that validated procedures be strictly followed by both factory personnel during manufacturing and by industry customers using these tools in support of government and commercial applications. Market forces are applying pressure to reduce manufacturing costs at the same time that expectations for quality are increasing and time-to-market windows are shrinking. The objective of this CRADA was to team the capabilities of Huffman and AlliedSignal Federal Manufacturing & Technologies (FM&T) in order to develop a Performance Support System (PSS). This project applies the expertise of FM&T in the area of advanced learning technologies with Huffman's knowledge of precision machine tool design and manufacturing to create a solution to performance support needs that uses the most appropriate technologies currently available.

C. Description

The objective of this project was to create a system that delivered the appropriate information to the machine tool user just when needed and in the most appropriate form. The expertise of FM&T in the areas of instructional system design and multimedia creation was employed. Huffman brought together their subject matter experts from engineering, manufacturing, technical writing, and technical support. AlliedSignal FM&T worked together with Huffman as a design team to determine what tasks must be accomplished throughout the machine tool production phases, who performs those tasks, what skills are utilized, and what information is required to support the tasks.

This project resulted in the identification of information flow throughout the life cycle of the machine tool products. Specialized tools required for assembly and calibration procedures were identified and their images captured, digitized, and stored for easy retrieval within the PSS. Subject matter experts were interviewed to determine which tasks require highly specialized knowledge and skills. These tasks were then performed on actual machines and the technicians' actions captured on video tape. The resulting video segments were edited, digitized, and integrated into the information system portion of the PSS where they are available for viewing alongside procedural information presented on the computer display screen of the machine tool controller.

Information from Troubleshooting experts were interviewed regarding the symptoms and root causes of system malfunctions. This knowledge was captured and fault trees were

developed. These trees were then incorporated into an expert system as a rule base. The troubleshooting portion of the PSS presents simple questions to the machine operator in order to determine the likely cause of malfunctions and then recommends corrective actions.

Newly created and existing Reference information was both created and re-purposed from other existing formats, then incorporated into the electronic information retrieval portion of the PSS. On-line reference manuals covering Operations, Maintenance, Mechanical, Electrical, and Peripherals provide text and illustrations to the machine operator in a traditional structure, but additionally offer the capability to search voluminous amounts of technical data and retrieve specific information on request.

This project provided the project team with a detailed understanding of the knowledge and information required to produce and support advanced machine tools. In addition it resulted in the design and construction of a prototype Grinders PSS that contains all the logic and interfaces necessary to integrate product information from the Huffman Waterjets and Lasers product lines.

D. Expected Economic Impact

Huffman expects to apply the developed technology on most of their product lines, allowing more efficient use of experts to address engineering challenges and spend less time on recurring and routine manufacturing problems. By running on the same Windows NT computer platform that controls the machine tool, this software solution now allows the machine operators to independently troubleshoot and repair malfunctions as well as visually review the proper methods of performing specialized tasks. This will decrease manufacturing engineering costs at the factory and service support costs in the field.

E. Benefits to DOE

This partnership has led FM&T to quickly understand the process of capturing knowledge across a manufacturing operation and designing an appropriate PSS that makes critical information available as needed. FM&T is presently evaluating this technology for incorporation into its operations that support DOE's non-nuclear manufacturing requirements. Our experiences can be shared with government and industry and offered as a model for an approach to matching the characteristics of a PSS to the target industry. Manufacturing operations both inside and outside of the Nuclear Weapons Complex (NWC) can adopt this model that allows for the integrated presentation of multiple forms of information. This technology is directly applicable to next-generation work instruction systems. Knowledge can be preserved and communicated by Contractors supporting Defense Programs (DP) can similarly employing the video storage and retrieval of experts performing critical manufacturing tasks, and thereby save and preserve such institutional knowledge to support current and future manufacturing efforts. Freeing engineers from manufacturing support roles will increase capabilities in R&D areas and promote faster response times to government RFPs and RFIs.

F. Industry Area

Manufacturing (including Automotive, Aerospace, and Machine Tool). The machine tool industry will benefit from incorporating models such as the one developed to increase the efficiency of engineering personnel and empower production and support personnel to solve a greater range of manufacturing problems. The PSS approach ensures that validated procedural information is presented to all users in a consistent way, thereby minimizing variations in procedures. Used over time, the PSS will become an archive of historical data where design and technical knowledge has been preserved long after products have ceased production but still require maintenance and support. The potential exists for this solution to become generally applied in the aerospace and automotive industries as well.

G. Project Status

The project was completed as scheduled.

H. Point of Contact for Project Information

Ken Bauer	Tom Ciccateri
US Department of Energy	AlliedSignal FM&T
Kansas City Area Office	PO Box 4339
PO Box 410202	Albuquerque, NM 87196-4339
Kansas City, MO 64141-0202	Telephone: (505) 768-1450
Telephone: (816) 997-3917	Fax (505) 768-1440
Fax: (816) 997-5059	

I. Company Size and Point of Contact

Huffman Corporation, Roger Hayes, President

Company size: 115 employees

(803)222-4561

(803)222-7599 fax

J. Project Examples

A functional demonstration CD-ROM is available that illustrates the technologies incorporated into the PSS design.

K.

L. Technology Commercialization

None.

L. Release of Information

I have reviewed the attached Project Accomplishment Summary prepared by AlliedSignal FM&T and agree that the information about our CRADA may be released for external distribution.

Original signed by Roger H. Hayes 2/23/98

Name: Roger H. Hayes Date

Organization: Huffman Corp.

Title: President