Light Machines Operator Performance Support System

Federal Manufacturing & Technologies

Maribeth C. Bohley

KCP-613-6027

Published June 1998

Final Report/Project Accomplishments Summary

National Machine Tool Partnership Agreement #96KCP1033

Approved for public release; distribution is unlimited.

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

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees,

makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade names, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Printed in the United States of America.

This report has been reproduced from the best available copy.

Available to DOE and DOE contractors from the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, Tennessee 37831; prices available from (615) 576-8401, FTS 626-8401.

Available to the public from the National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Rd., Springfield, Virginia 22161.

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

KCP-613-6027

Distribution Category UC-706

Approved for public release; distribution is unlimited.

LIGHT MACHINES OPERATOR

PERFORMANCE SUPPORT SYSTEM

Maribeth C. Bohley

Published June 1998

Final Report/Project Accomplishments Summary

National Machine Tool Partnership Agreement #96KCP1033

Light Machines Operator Performance Support System

Project Accomplishments Summary

National Machine Tool Partnership Agreement # 96KCP1033

Date: 9/26/97

Revision: 0

A. Parties

The project is a partnership between

AlliedSignal FM&T

Light Machines Corporation

2000 E 95th Street

444 East Industrial Park Drive

PO Box 419159

Manchester, NH 03109-5317

Kansas City, MO 64141-6159

B. Background

Light Machines Corporation provides small scale machine tools to both the industrial and vocational-education markets. Initially, representatives from Light Machines identified a need to provide new users of their machine tools with an operator performance support

system (OPSS) by developing an in-house capability for creating multimedia performance support programs. The initial partnership project proposal included a Personnel Exchange between Light Machines and AlliedSignal Federal Manufacturing & Technologies (ASFM&T). The intent was to transfer knowledge of multimedia design and development from the ASFM&T DOE facility to the industrial partner. When Light Machines was unable to hire personnel to participate in this exchange program, the tasking changed from transferring multimedia knowledge through personnel exchange to the development of an operator performance support system shell for use with Light Machines Benchman VMC-4000 and capable of being expanded in the future by Light Machines' staff.

Light Machines identified a market need for a method of delivering specialized performance support information to student/novice machine tool operators, technicians, and machinists in support of product manufacturing, machine setup and maintenance, machine tool safety, and sophisticated tooling operations. This market need continues to be generated by the increasing levels of complexity involved in the selection, assembly, calibration, and operation of high-precision machine tools.

This project applies the expertise of ASFM&T in the area of advanced multimedia and performance support technologies with Light Machines' knowledge of precision machine tool design and manufacturing. The resulting OPSS is a solution for meeting performance support needs of student or novice machine tool users which incorporates the best technologies currently available.

C. Description

The objective of this project was to create a multimedia OPSS shell that would provide a framework for delivering appropriate information to the student/novice machine tool user just when needed and in the most appropriate form. In addition, the program was designed so that it could be expanded and further developed by Light Machines personnel. The expertise of ASFM&T in the areas of performance support system design and multimedia creation was employed to create the most user-friendly graphical user interface (GUI) while providing access to key topical areas. Light Machines provided a subject matter expert from their technical services group in order to provide the needed information for structuring the OPSS shell. They also provided a Benchman VMC 4000 machine tool at the ASFM&T New Mexico location as well as specific instruction on the safe and effective use of that machine tool.

AlliedSignal FM&T worked together with Light Machines as a design team to determine which areas of the tooling process should be included in an OPSS for student/novice operators. This joint effort resulted in an OPSS shell that included the following elements.

1. Machine Tool Safety
 1. System Hardware of the VMC-4000
 1. CNC Programming
 1. Machine Tool Terms and Concepts
 1. System Controller Software of the VMC-4000
 1. Machine Maintenance & Troubleshooting
 1. System Operations & Procedures
 1. Single-Tool Machining Examples

1. Multiple-Tool Machining Examples

Of these nine elements, Light Machines identified the machine tool safety topic to be developed by ASFM&T. The intent was for ASFM&T to complete one path in the OPSS shell program and provide programming models that could be re-used by Light Machines personnel to fully complete the OPSS at a future date. Together, Light Machines and ASFM&T identified four OPSS models including a digital video model, digital audio model, paging model, and highlighting mouse-rollover model, for future OPSS development. Light Machines provided reference information which was converted by ASFM&T from existing formats (print, slides, and manuals) to digital graphics, digital video, digital audio, and electronic text. This information was then included in the shell and, specifically, in the machine tool safety section of the OPSS. A copy of the source code for the OPSS shell, along with all of the digitized resource files, was delivered to Light Machines for further program development.

This project provided the ASFM&T team with a detailed understanding of the knowledge and information required to operate and support small machine tools. In addition, it resulted in the design and construction of an OPSS program shell for the Benchman VMC-4000 containing all the logic, models, and interfaces necessary to integrate information from any of the Light Machine Tools product line.

D. Expected Economic Impact

Light Machines expects to apply the developed technology to most of their product lines, allowing more efficient use of their experts to address engineering challenges and spend less time on recurring and routine manufacturing and educational problems. By running on the same Windows 95 or NT computer platform that controls their machine tools, this OPSS software solution will allow student/novice machine tool operators and their instructors to independently troubleshoot and repair malfunctions as well as visually review the proper methods for performing specialized tasks. In industrial applications, this will decrease manufacturing engineering costs at the factory. In educational applications, this will increase student success and ensure greater safety in learning the operation and maintenance of machine tools. For both applications, the OPSS will reduce the frequency of service support calls to Light Machines from the field.

E. Benefits to DOE

This partnership has educated DOE's ASFM&T in the process for capturing knowledge across a manufacturing operation and designing an appropriate performance-based system providing critical information as needed. ASFM&T is presently incorporating this technology into operations that support DOE's nonnuclear manufacturing requirements by applying it to other DOE initiatives such as Knowledge Preservation.

In general, DOE manufacturing operations, both in and outside of the Nuclear Weapons Complex, can benefit from this partnership by using the performance support system

technology, which allows for the integrated presentation of multiple forms of information in machine tool operations as well as other manufacturing processes, to provide a consistent method for operating, maintaining, and troubleshooting work processes.

This project provided the ASFM&T team with a detailed understanding of the knowledge and information required to operate and support small machine tools. In addition, it resulted in the design and construction of an OPSS program shell for the Benchman VMC-4000 containing all the logic, models, and interfaces necessary to integrate information from any of the Light Machine Tools product line.

The Light Machines Benchman VMC-4000 operator performance support system will be used in industrial settings, vocational education, and junior and senior high school industrial arts classes. It will provide hands-on capabilities for learning CNC machining, programming and coordinate geometry for the next generation of DOE machinists and machine tool operators. Though less tangible, this benefit ensures that the DOE will have a fully trained technical workforce available in order to fulfill its future, as well as present, mission. While this benefit to DOE points to the future, an immediate benefit is noted in that this OPSS compliments DOE's current initiatives in encouraging and supporting manufacturing, math, science, and engineering education in the schools.

F. Industry Area

Manufacturing (including Automotive, Aerospace, Machine Tool). The machine tool industry will benefit from incorporating OPSS models to increase the efficiency of engineering personnel and empower production and support personnel to solve a greater range of manufacturing problems. The OPSS approach ensures that validated procedural information is presented to all users in a consistent way, thereby minimizing variations in tooling processes and procedures. Used over time, the OPSS will be an archive of historical data preserving design and technical knowledge long after organizations 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. Finally, the machine tool industry will benefit from a future workforce that is well informed about machine tool safety precautions and protocols as well as highly skilled and prepared for immediate participation in the machine tool industry.

G. Project Status

The project was completed as scheduled.

H. Point of Contact for Project Information

Ken Bauer	Maribeth Bohley
US Department of Energy	AlliedSignal FM&T
Kansas City Area Office	2100 AirPark SE
PO Box 410202	Albuquerque, NM 87106
Kansas City, MO 64141-0202	Telephone: (505) 247-1504
Telephone: (816) 997-3917	Fax (505) 768-1440
Fax: (816) 997-5059	

I. Company Size and Point of Contact

Light Machines Corporation, Bill Kallgren, Technical Services Manager

Company size: 55 employees

(603)625-8600 Ext. 109

(603)625-2137 fax

J. Project Examples

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

K. Technology Commercialization

None.