Preface to "Flexibility in Manufacturing: A Proposal for Study"

Dana Nau
Department of Computer Science and
Institute for Systems Research
nau@cs.umd.edu

Mark Sloan
Department of Sociology and
Institute for Systems Research
s-msloan@bss1.umd.edu

University of Maryland, College Park, MD 20742

Abstract

This is a preface to (Neumann *et al.* 1998), which is the next paper in the conference proceedings.

Introduction

Most research groups that have tried to develop applications of AI research to manufacturing problems have become painfully aware of the problems caused by the different world-views of AI researchers and manufacturing engineers. As discussed in (Nau *et al.* 1995), engineers and AI researchers tend to have very different sets of assumptions about what the important research problems are, what the best ways are to work on those problems, and what constitute good solutions. More specifically:

- Since AI researchers are usually more interested in general conceptual problems than domain-dependent details, the AI approach to manufacturing planning has typically been to create an abstract problem representation that omits unimportant details, and look for ways to solve the abstract problem. From the viewpoint of the manufacturing engineer, these "unimportant details" often are very important parts of the problem to be solved—and this can lead manufacturing engineers to view AI planning techniques as impractical.
- Manufacturing researchers typically want to solve specific manufacturing problems, and present their research results within the context of these problems, without discussing how the approach might generalize to other planning domains. For AI researchers, this makes it difficult to see what the underlying conceptual problems are, or whether the approach embodies a general idea that can be applied to other problems. This can lead AI researchers to view manufacturing as a domain full of ad-hoc, domain-specific programs rather than general principles and approaches.

Because of these "cultural differences," researchers who tackle interdisciplinary problems in AI and manufacturing must often spend several years before they have learned enough about what is considered important in both disciplines that they can do effective research. This is a considerable impediment to doing effective interdisciplinary work. In order to overcome this problem, ways are needed to train students to think about problems in an interdisciplinary manner. The following paper, "Flexibility in Manufacturing: A Proposal for Study" by Neuman *et al.*, represents the results of an effort to do that.

"Flexibility in Manufacturing: A Proposal for Study" is a proposal for a multi-year undergraduate research project on flexible manufacturing, which was written by a group of six exceptionally talented undergraduate students. The students are members of a new interdisciplinary honors program at the University of Maryland called the Gemstone program (the next section gives a brief overview of this program). They come from a several different academic majors, including Business, Decision Information Sciences/Finance, Electrical Engineering, Mechanical Engineering, and Theater Performance. Over the last four months they have worked together as a team to write this proposal, and during the next two years they will work together as a team to carry out their proposed work.

The students developed their ideas on their own. However, we worked with them closely to ensure that they worked well together as a team, that they thought carefully about what ideas were realistic and worthwhile, and that they considered how to handle various problems that might arise in carrying out their proposed work. Although their proposal is not a typical conference submission, we support its inclusion here for the following reasons:

1. It provides an example of how we are training undergraduates to do interdisciplinary work on manufacturing. This may help others think about how to develop similar interdisciplinary programs elsewhere.
2. By presenting their work at the SIGMAN workshop, the students will get a chance to discuss their ideas with experienced researchers. We believe this will help them develop better ideas of how to carry out their proposed project.

Overview of the Gemstone Program

The following material is adapted from (Institute for Systems Research 1996).

The University of Maryland's Gemstone program, which began in Fall 1996, is a new interdisciplinary education

program for undergraduate honors students. The Gemstone program places students in multidisciplinary teams for their undergraduate years. Each team undertakes a long-term research project addressing a crucial societal problem such as energy-efficient transportation, urban housing, waste management or biological engineering.

The Gemstone program is administered by the Institute for Systems Research (ISR). ISR was the natural organization to lead the effort because it is the largest unit on campus dedicated to interdisciplinary research and education, and already had a number of complementary programs in place for high school students, undergraduates and graduate students. ISR faculty and staff are involved in designing the Gemstone program in addition to their administrative duties.

More than 100 entering freshman students were selected on the basis of academic promise and their potential to interact effectively. All are honors students with an average SAT score of 1400. Each team contains approximately 12 undergraduates from engineering and other sciences, business and management, behavioral and social sciences, and the humanities.

The teams take special courses that emphasize the relationship between technological innovation and social change from the perspectives of sociology, political science, history and business. Student teams will meet regularly during the academic year to investigate and analyze their assigned problem. By the end of the senior year, each team will produce a book-length thesis containing results from background, analysis, design, testing and implementation studies as well as a description of the proposed solution, its potential societal impact and a business plan for implementation. Faculty advisors and selected industry experts in the field evaluate each team's proposal.

Students will address an aspect of the problem related to their undergraduate major. Engineering and science majors will investigate both theoretical and experimental technological solutions. Humanities and behavioral and social sciences students will address the history and societal impact of the problem, while business and management majors will concentrate on finance and marketing issues. Students completing the program are awarded a Gemstone designation on their baccalaureate degree.

University officials hope the Gemstone concept will help Maryland stake out a national presence as a leading innovator in undergraduate education.

William Destler, dean of the A. James Clark School of Engineering, originated the Gemstone idea. He says it addresses two of the most common criticisms of modern undergraduate education: the lack of an integrative experience to provide a context for learning, and the failure to provide meaningful interactions between students in different disciplines. "Society has not been as effective as we might have been at bringing such diverse talents together toward the solution of major societal problems," Destler says. "The University of Maryland is a pioneer."

Core funding comes from General Electric and AT&T, which are investing a combined total of $370,000 over four years. Additional support comes from IBM through its Total Quality Program at the University of Maryland.

One Gemstone goal is to incorporate "real life" experience relevant to the students' research focus by providing internships or other work opportunities in industry and government. For further information about Gemstone, please contact Vickie J. Claflin, program coordinator, at 301-405-6564; e-mail vclaflin@isr.umd.edu.

References

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