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AGILE PEOPLE: REALIZING & TRAINING A HIGHLY MOBILE WORK FORCE

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Abstract

This paper describes the development of instructional material and educational tools which are appropriate to support the new agile workforce. Supporting examples are presented from an innovative pilot program for workforce training being created by the Greenfield Coalition and the Focus:HOPE Center for Advanced Technologies, Detroit, MI. This activity is partially funded by the National Science Foundation. The paper concludes with some early examples of courseware dissemination facilitated by laboratories in the Enterprise Systems Center at Lehigh University.

Introduction and background

An important resource of any agile company is its human resources. This manpower helps ensure quality, increase customer value, optimize resources, make an organization flexible and dynamic. It also constitutes the knowledge base that defines the firm's competitive position.

Currently, a large need exists in the marketplace for a well-trained workforce. Lehigh University, one of the pioneering institutions for agility, is collaborating with the Focus:HOPE facility in Detroit and other members of the N.S.F.-sponsored Greenfield Coalition to help develop and test out new educational techniques. It is likely that the results and work products of this program will be useful in the training of a highly mobile, agile work force.

Beginning in the summer of 1994, the Greenfield Coalition has been testing and evaluating new approaches to workforce education at the Focus:HOPE Center for Advanced Technologies. The Coalition includes six universities working in partnership with Focus:HOPE and various industrial partners to develop and pilot innovative educational processes which serve to craft the agile workforce. The university partners are: University of Detroit-Mercy (lead institution), Central State University, Wayne State University, Lawrence Technological University, the University of Michigan and Lehigh University.

One underlying principle behind the Greenfield Coalition's approach to education is that the best way to prepare students for the world of agile manufacturing is to expose them to an operational manufacturing factory in combination with many aspects of a traditional university education. Based on this approach, potential candidates for degrees working in the Focus:HOPE factory receive extensive training and education while simultaneously producing high quality products in a real manufacturing environment.

The Focus:HOPE organizational structure provides a state-of-the-art environment for continuous learning. The students are given the opportunity to practice the skills and techniques discussed in the classroom setting in an environment that is familiar. One way this is accomplished is by bringing real-time factory applications into the classroom. Focus:HOPE-based case studies.

In addition, educational developers believe that working effectively in today's manufacturing organization requires an understanding of the business as a whole. New challenges have been posed to engineers as they have been asked to assume a more entrepreneurial role as businesses become more agile. Engineers are now required to think laterally, crossing multiple disciplines within the organization. This approach reflects the belief that the agile firm is less narrow and more holistic in nature.

Based on initial evidence from the pilot activities at Focus:HOPE, it is likely that these instructional approaches will help manufacturing engineers obtain an enterprise-wide view of the business world. This can largely be accomplished by instructing them on how to analyze and design manufacturing systems built on agile principles in the context of real-world examples.

Educational approach and manufacturing systems knowledge area example

Learning how to analyze and design manufacturing systems in the context of real-world examples will help potential manufacturing engineers gain an enterprise-wide view of the business world. Thus, the introductory manufacturing systems knowledge area encompasses several key areas in the study of manufacturing systems. The development process utilizes direct linkages to the daily experiences and activities of the Focus: HOPE students on the factory floor. Mastering these curriculum components, or modules, will set in place a foundation for future study and "elective" courses in specific topic areas. The knowledge area approach emphasizes an understanding of individual elements of a manufacturing system, as well as stressing technical competency in techniques to analyze and design fully integrated systems. The intended result is an engineering education that emphasizes real-world experience by hearing, seeing, and doing in one facility.

A brief description of the modules included in a two-year manufacturing systems knowledge area pilot effort being developed by Lehigh, Central State and Wayne State universities is as follows:

Fundamentals of Manufacturing Systems Design. This essential introductory module of the first-year offering of the Manufacturing Systems Knowledge Area provides an overview of manufacturing systems design. Students learn about the various types of manufacturing systems, such as job shops, project shops, batch production, cellular systems, flow lines and continuous systems. This module also introduces the students to the methods and tools used for manufacturing systems analysis and design. Students are also introduced to common industry practices in manufacturing systems design.

Analysis Techniques. By learning about and practicing various techniques in a real-world setting, graduates will be able to dissect a manufacturing system into its elements and understand their interactions. In this module, students learn how to construct and make use of graphical representations of manufacturing systems. In addition, students learn how to

mathematically model a manufacturing system using the Cincinnati Milicron engine component line or the Detroit Diesel pulley production activity at the Focus: HOPE facility as case studies. The curriculum also includes the use of computer simulation as a tool to help the student to learn how to analyze the operations of a manufacturing system. The above-described approach helps students in solving unstructured problems similar to those they will encounter in industry.

Communications and Networking. It is planned that this module will give students an introductory understanding of how networking and data communication technologies enable them to realize and implement operational strategies, such as those based on agility and concurrent engineering. With the advent of improved information system technologies, an understanding of networking and communication capabilities is becoming increasingly important to manufacturing operations. Students also learn how manufacturing activities are integrated with other business and engineering processes of the enterprise and how networking can facilitate these ties. Team projects, case studies and exercises utilize a virtual prototyping approach to the learning process. After this module they will be ready to take further course work in areas such as database systems design.

Human Factors. The manufacturing systems curriculum stresses human factors as a vital issue to an organization's success. Graduates will be able to assess the effects of the working environment on employee efficiency, loyalty, productivity, creativity, and enthusiasm. In this module, human factors issues are tied to actual student experiences in the Center for Advanced Technology. Team projects tied to real-world, unstructured problem solving are being developed and tested. The case-study method will be the primary delivery vehicle.

New operational models. New operational models play an increasingly important role in competitiveness as we enter the next century. Therefore, it is important that engineering education presents at least several of these cutting-edge manufacturing concepts. The curriculum will give students an understanding of the current issues and developments in manufacturing technologies and theory, such as agile manufacturing, just-in-time (JIT), synchronized manufacturing, and total quality management (TQM). In each case, these will be mapped against the appropriateness of the model or technique for the specific case problem at hand. Graduates will be able to apply new operational models to the design or re-engineering of traditional manufacturing systems. New developments as the result of research in the field will be continuously introduced in this module. Relevancy determination will include strong industry input to the review process. This module is a foundation for students who want to take additional courses in new operational models.

Systems (Operations) Management. An engineer's role in manufacturing is an integrated one. Therefore, the curriculum will introduce students to issues and techniques in operations management. With module elements linked into other components of the manufacturing model, graduates of the program should have a solid understanding of the dynamics behind creating a new product and operating the enterprise which produces it.

Planning and Executing Change. Finally, the manufacturing systems knowledge area will cover the development of effective strategies for planning and executing change. It is anticipated that graduates of this program will become agents of change. They will be sought by companies that want to remain successful by use of effective strategic planning and design when attempting to implement new technologies. Graduating engineers must understand how to harness new technologies in a way that will be of greatest benefit to their company and have the confidence and leadership qualities to carry out implementations. Students will learn to align these technologies with the basic business model. It is anticipated that student-

run companies will eventually work in partnership with industry to design or re-engineer manufacturing systems operations.

Computer-based tools support agile workforce training

Lehigh University and other coalition partners are developing computer-based lessons to complement and enhance more traditional classroom instructional techniques. In an effort to ensure that these computerized educational aids remain agile, Lehigh University developers are incorporating computer-based techniques into the general flow and structure of the multimedia lessons which facilitate capture of user commentary and suggestions. Thus, industry reviewers and the students themselves provide frequent feedback in the development of the computer-based lesson material. It is believed that this partnership and interaction during the preliminary development process enhances the quality and usefulness of the final educational products. Moreover, in subsequent years the ability to obtain on-going user feedback will ensure that the computer-based educational tools remain flexible and dynamic, continuously changing in response to the needs of the students and industry, as well as further technological advances.

Provisions are being made to capture multiple points-of-view in the explanation and presentation of the mainstream course material. It is believed that this approach will improve the effectiveness of the computer-based format as an educational tool. It takes into account the fact that different people learn in different ways and enables the user to focus on the particular method or style of explanation that best suits his or her individual learning style. Furthermore, the student also receives a more well-rounded educational experience by being exposed to such diverse perspectives, rather than merely absorbing only the traditional academic outlook. For example, the typical classroom explanation of queuing theory is strengthened via the computer-based format by presenting video footage of an employee on the factory floor describing how bottlenecks affect his work performance and an industry executive explaining the consequences of such buildups on the overall functioning of his organization. Thus, the student gains exposure to the full scope of the material, as the academic concept is coupled with the real-world applications of the theory.

Realizing that the electronic devices which support computer-based learning are changing and improving almost daily, development at Lehigh University to date has been guided by looking toward what we will be able to do tomorrow rather than focusing on what we can not yet do today. While the Lehigh developers have been working within current technology constraints to create an educationally viable support for the other, more traditional courseware, they have also been building mechanisms into the structure of their efforts to facilitate the incorporation of what are sure to be inevitable advances in the technology in the near future. For example, current networking, storage and processor restrictions make the use of real-time, full-screen video difficult, so at this time students are being directed to an external video source until the technology can better support a fully integrated presentation.

Dissemination at Lehigh University

The Enterprise Systems Center serves as a test bed for new educational approaches and helps to promote their dissemination. The Center supports real-time video links to the Focus:HOPE facility. In-depth simulation programs and interactive multimedia presentations provide a valuable new dimension to the educational process. Case studies and laboratory exercises captured in multimedia format allow students to develop a better understanding of new material and practice solving unstructured problems. The classrooms used are equipped with networked personal computers, providing real-time feedback from the factory simulations.

By linking in real time with the Focus:HOPE industrial partners, the laboratory hosts electronic tours to state-of-the-art manufacturing processes and facilities. This will create a unique learning environment that can be used to complement laboratory coursework through "virtual" hands-on experiences and video and audio links to industrial leaders working with the Focus:HOPE center. Industrial leaders give short electronic talks to students during class, sharing real-world leadership experiences on the subject being discussed. Two-way video and audio links support close collaboration with Focus:HOPE personnel in undergraduate research and design projects.

Concluding Comments

The agility vision will be more readily accomplished if an enterprise is able to realize a well-trained, mobile work force. The new educational paradigm created and piloted by the Greenfield Coalition may be helpful in achieving this agile workforce. This pilot program at Focus:HOPE is now in its second year and provisions are presently being made for the Agility Forum to be continuously informed of progress so that members can take advantage of educational materials when they become formally available.