ADA FOR FLEXIBLE MANUFACTURING: FOUNDATION FOR SUCCESS

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PROBLEMS/CHALLENGES IN FLEXIBLE MANUFACTURING

- MASSIVE INFORMATION MANAGEMENT & CONTROL
- LABOR COSTS MOSTLY IN WHITE-COLLAR CATEGORY
- RAPIDLY-CHANGING MARKET REQUIREMENTS
- RAPID & SIGNIFICANT CHANGES & IMPROVEMENTS IN H/W
- NEED FOR STANDARDS
- DEARTH OF "COTS" SOFTWARE

Manufacturing technology (MANTECH) is a very broad-based discipline, encompassing a wide range of technologies. While the common focus of MANTECH-related programs is machine technology, the real key to flexibility in manufacturing lies in the control of massive amounts of information. Flexible manufacturing (FM) should be addressed in the context of the entire product life cycle, including preliminary design engineering, production engineering, manufacturing, logistics support, and inventory control. This "manufacturing in the large" perspective serves to emphasize the magnitude of the FM information control challenge.

A successful strategy for implementing FM technologies must take into account the fact that only about 20% of U.S. manufacturing operations are truly automated. Additionally, 70% of total manufacturing labor costs are white-collar expenditures, often related to the generation and attempted control of massive volumes of information. The manufacturing marketplace is changing rapidly, and is lacking in widespread standards for information technologies.

FOUNDATION FOR F/M SOLUTIONS

AS AN INFORMATION-DRIVEN PROBLEM, THE SOLUTION IS BASED ON INFORMATION TECHNOLOGY (IES)

THIS LEADS TO A FOCUS ON COMPUTER SYSTEMS.

A COMPUTER SYSTEMS FOCUS, IN TURN, LEADS TO EXAMINATION OF COMPUTER H/W AND S/W.

WITH 80-85% OF COMPUTER SYSTEMS DEVELOPMENT $$ BEING SPENT ON S/W, AND 70-75% OF LIFE CYCLE $$ BEING SPENT ON S/W MAINTENANCE, S/W IS A CRITICAL FOCAL POINT FOR F/M.

Without question, the future of U.S.-based manufacturing technology and competitiveness is dependent upon efficient, cost-effective, automation. Automation, in turn, is wholly dependent on computerization, from the automated control of equipment to the accurate and timely production of management reports and accounting data, to the use of sophisticated CAD/CAM systems for product description and design.

When addressing the automation/computerization of any system, the primary focus MUST be on software. Software comprises the most expensive, most complex, most time-consuming, most critical, and most misunderstood part of any computerized application. Effective automation/computerization is totally reliant on the development and use of reliable, functional software.

AN ENGINEERING DISCIPLINE IS NECESSARY FOR LONG-TERM SUCCESS IN F/M

- SYSTEMS ENGINEERING FOR PLANT AND FACILITIES
- H/W & MACHINE ENGINEERING FOR PRODUCTION
- S/W ENGINEERING FOR LONG-TERM ROI & AUTOMATION

Engineering disciplines are widely understood and applied in the non-software areas of manufacturing. Manufacturing plant and facilities engineeering techniques are routinely applied and accepted. Likewise, hardware and machine engineering technologies are utilized throughout the manufacturing process. Software engineering, on the other hand is not understood, nor recognized, nor applied, as a critical part of manufacturing applications.

If flexible manufacturing is to become viable, its implementation must be considered in a long-range timeframe; there are no "quick hits" or fast returns to be gained in the FM marketplace. Given that long-term perspective, it is clear that an engineering discipline, for ALL facets of flexible manufacturing, is essential to success.

It is clear that a strong software engineering discipline be used as the foundation for any long-term flexible manufacturing application.

ENGINEERING ORIENTATION REQUIREMENTS

- HIGHLY-SKILLED, WELL-TRAINED PEOPLE
- KNOWLEDGEABLE MANAGEMENT WITH LEADERSHIP TALENT
- COMMITMENT TO QUALITY
- LONG-RANGE PLANNING FOR LEVERAGE & ROI
- GOOD TOOLS & ENVIRONMENTS
- STANDARDS

As with any engineering-oriented application, highly-skilled, well-trained people are essential for success. In the software engineering arena, the focus tends to be (exclusively) on technical people. Most organizations make the major mistake of overlooking or ignoring the necessity of having highly-skilled, well-trained, NON-technical personnel. For a FM program, the need for knowledgeable management people is an absolute, as is the need for knowledgeable and capable marketing personnel.

In a market where customer demands and technologies are in a constant state of rapid change, management and marketing talent is oftentimes more important to success than is technical talent. "Management" sets the tone for the entire operation; the "corporate culture" is established by the higher levels of management; these people are responsible for setting a strong commitment to quality throughout the organization. They must be strong enough and aware enough to take a long-range view toward developing and implementing FM engineering disciplines, particularly in software.

When combined with good tools and environments, as well as intelligent standards, a solid "people resource" base assures a high chance for success.

S/W ENGINEERING REQUIREMENTS

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- KNOWLEDGEABLE MANAGEMENT WITH LEADERSHIP TALENT
- COMMITMENT TO QUALITY
- LONG-RANGE PLANNING FOR LEVERAGE & ROI
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- STANDARDS

Contrary to popular belief, the requirements for sound software engineering are the same as for other engineering disciplines.

The key point here is that a sound flexible manufacturing strategy must rely on sound, committed people. Too often, the focus is placed on technology issues, with the "people assets" overlooked.

Given that software is the most expensive and critical aspect of a high-quality flexible manufacturing program, the software engineering talent, both managerial and technical, comprise the most valuable resource for success.

S/W ENGINEERING TOOLS & STANDARDS

- LIFE CYCLE ORIENTATION FOR DESIGN & COSTING
- TOOLS TO SUPPORT S/W ENGINEERS (NOT SUPPLANT)
- EXPLICIT SUPPORT FOR S/W ENGINEERING
- PROGRAMMING LANGUAGE THATIS AN INTERNATIONAL & ANSI STANDARD
- LANGUAGE & TOOLS THAT ARE DESIGNED FOR LONG TERM

As mentioned earlier, it is important to approach a FM program with a full manufacturing life cycle perspective. This is even more important in FM software. Complete life cycle design criteria will enable the FM organization to accurately determine real system costs, and will facilitate the reuse and migration of software across different phases of the manufacturing life cycle.

The life cycle orientation should also drive the selection and integration of appropriate software tools. These tools should be selected to SUPPORT the activities of software engineers, as opposed to being substitutes for software engineering talent. The tools must be selected for their explicit support of software engineering, as opposed to any promised "shortcuts" that purport to eliminate the need for engineering discipline.

The choice of a programming language should be made on the basis of its overall support of software engineering. Given that a language contains explicit engineering support, its acceptance as an international standard will be a strong secondary criteria for selection.

ADA AS A F/M LANGUAGE

- DESIGNED EXPLICITLY FOR S/W ENGINEERING
- WIDELY-ACCEPTED ANSI & INTERNATIONAL STANDARD
- DESIGNED FOR USE INTO THE 2000'S
- WEALTH OF TRAINING, TEXTS, & DOCUMENTATION
- REQUIRES LONG-TERM VIEW FOR ROI
- BROAD APPLICABILITY FOR INFORMATION PROCESSING & REAL-TIME SYSTEMS

Clearly, the Ada programming language encompasses all of the criteria required to support a well-engineered flexible manufacturing application. Ada was designed and developed to explicitly support the principles of software engineering. It is an internationally-accepted standard, with a rigidly-enforced validation process. The language has been designed to address complex computing requirements into the 2000's.

Ada has already been used for a broad spectrum of applications, including real-time military and commercial use, MIS applications, process control, robotics, AI, and business systems. Given this proven breadth of fielded applicability, it is ideally suited for flexible manufacturing systems.

THE "DOWNSIDE" OF ADA FOR F/M

- **REQUIRES SIGNIFICANT INVESTMENT IN $$, PEOPLE, & EQUIPMENT**
- **NO SHORT-TERM ROI**
- **DEARTH OF "COTS" S/W FOR F/M**
- **BAD PRESS/MISCONCEPTIONS ABOUT THE LANGUAGE & ITS APPLICATION DOMAINs**
- **LACK OF S/W ENGINGEERING EXPERTISE IN MARKETPLACE**

Ada should not be touted as a panacea for flexible manufacturing, nor should the benefits of using Ada be oversold. A commitment to the use of Ada and software engineering requires a major investment in people, equipment, time, and capital. The return on an Ada investment will not be realized in the first six months of an FM program. More likely, an ROI will begin to accrue in an 18-24 month timeframe.

There is virtually no Ada software at all that is available "off-the-shelf" for FM applications. There are, however, literally millions of lines of Ada code that can be used in building FM systems. Further, there are hundreds of compilers, tools, and environments that can be used for the design and development of FM software.

There will likely be significant resistance in the marketplace, due to widespread misconceptions about Ada, particularly its applicability for non-military systems. This "bad press" situation is exacerbated by the tremendous shortage of skilled software engineering talent in the market today.

SUMMARY

- THERE IS NO REASON WHY ADA CANNOT BE USED FOR F/M
- ADA FOR F/M MEANS LONG-TERM INVESTMENT--NO QUICK ROI
- MARKETING & COMMUNICATIONS AT LEAST AS IMPORTANT AS TECHNOLOGY ISSUES
- FOREIGN ADA INVESTMENTS INDICATE THAT TIME IS OF THE ESSENCE
- WELL-ENGINEERED ADA S/W GIVES MAXIMUM FLEXIBILITY FOR MANUFACTURING IN THE FUTURE

There are no technical reasons that preclude the use of Ada for flexible manufacturing applications; ample tools, environments, and compilers are available today. Ada training is also widely available from a variety of sources, for both technical and management/marketing personnel.

Using Ada means changing the timeframe for expecting an ROI--there is no quick turnaround on the Ada investment. This necessitates an in-depth understanding of software-related issues by all levels of management. Because of the "cultural" changes required, an informed and capable marketing/communications talent is essential in overcoming uninformed biases against software investments.

Several foreign organizations have already made significant investments in Ada for manufacturing applications. For U.S. industry to regain its competitive position in worldwide markets, time is of the essence in implementing sound software engineering capabilities in manufacturing enterprises.

In an engineering context, Ada provides maximum flexibility and the highest long-term ROI for manufacturing applications.