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EFFECTIVE AND STRATEGYSLANTS TO COMPUTER UNIFIED MANUFACTURING IN ELECTRONICS MANUFACTURING AND ASSOCIATION

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ABSTRACT

State-of-the-art production facilities require a wide variety of intelligent devices and automated processing equipment to be integrated and linked together through a manufacturing network in order to achieve the desired, cost effective, co-ordinated functionality. Devices within a manufacturing system may include: programmable logic controllers (PLCs), direct numerically controlled (DNC) machines, sensors, robots, vision systems, co-ordinate measurement machines (CMMs), personal computers (PCs), and mainframe computers, supplied by different vendors, using different operating systems, with different communication needs and interfaces. The successful integration of existing equipment using existing communication protocols and networks is crucial to achieve the functionality required for computer integrated manufacturing (i.e., CIM) systems. As a result, the performance of communication networks has become a key factor for successful implementation of integrated manufacturing systems, particularly, for time-critical applications. Hence, the analysis, design and performance evaluation of manufacturing systems can no longer ignore the performance of the communication environment.

INTRODUCTION

The product development environment typically suffers from a number of shortcomings. Some are partly due to the lack of integrated tools that information technology (IT) management has to deal with (Stark, 1992; Tonshoff and Dittmer, 1990) regularly. While others are partly due to the diverse nature of an enterprise's business operations (Pawar and Riedel, 1994; Dong, 1995; Bauman, 1990). Too often, tool-related shortcomings are caused by inappropriate or inadequate computer groupware or information aids ± such as hardware and software tools to needed database management tools, knowledge-ware, intelligent technologies and standardization (Althoff, 1987). Technology is used here in a generalized sense, similar to its definition in Webster's Dictionary (1990) ± ``the totality of the means employed to provide objects necessary for human sustenance and

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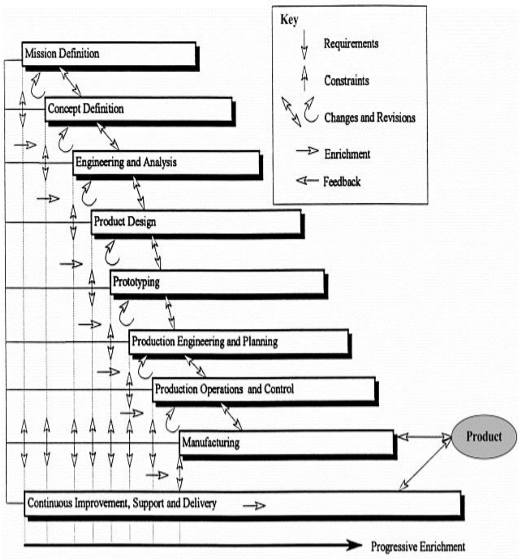
comfort." For example, by standardizing the design plans, tools and databases of all departments, Toyota enabled design work to overlap between stages. Downstream processes were started while upstream design plans were still being completed (Okino, 1995).



Basis of decision making in CE

The concept of CE was initially proposed as a potential means to minimize the product design development and delivery (PD3) time (DARPA, 1987). Since then, many interpretations of ``concurrent engineering (CE)" have emerged in literature (Zhang and Zhang, 1995). Today, CE is much more encompassing. Expectation ranges from a modest productivity improvement to a complete push-button type automation, depending upon the views expressed. CE is a parallel approach ± replacing the timeconsuming linear process of serial engineering and expensive prove-outs (DARPA, 1988). It is intended to elicit the product developers, from outset, to consider the ``total job" (including company's support functions). CE has a major impact on the process setup, and on the way an organization conducts the PD3 business. As shown by Zhang and Zhang (1995) and Prasad (1996), CE replaces the traditional sequential ``over the wall" approach to a simultaneous design and manufacture approach with parallel, less interrelated processes. It aims at reducing the total effort in bringing the product from its concept to delivery, while meeting the needs of both the consumers and industrial customers.

The four major phases of the product design and development (as shown in Figure 2.26 (Prasad, 1996)) have been detailed into nine tracks running in parallel. Figure shows the different tracks of the development process. These tracks are: mission definition, concept definition, engineering and analysis, product design, prototyping, production engineering and planning, production operation and control, manufacturing, and finally, support and delivery. The continuous improvement ± ``support and delivery" ± is an ongoing coordination track, which runs for the full lifecycle. This track provides, besides normal project management functions, sequencing, cooperation and central support to the other tracks. These tracks are not unique to any particular product, steps and overlaps may differ from product to product.

More and more people are looking to software to be a teacher, expert advisor, organizer, problem solver and specialized librarian, in addition to its more traditional function of being a ``productivity tool." They expect the software to teach them better ways of doing their work. Some are seeking new, better, and more enjoyable work environments (e.g. multi-media,

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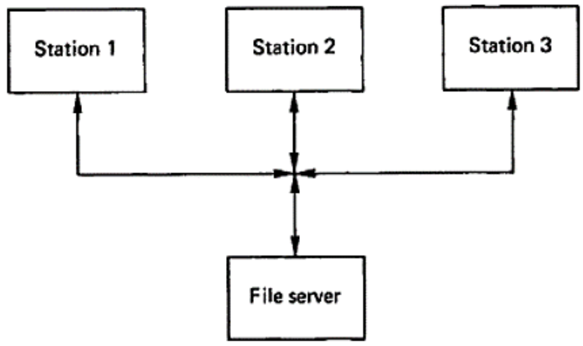
windows, etc.). And a growing number is looking to software to help them do things that they have never done before. Software vendors are also responding with better capabilities, more efficient environments, faster processing, and all-in-one integrated tools.

Levels of information enrichment

There are various types of activities that take place in product design and development. On the one hand, there are repeated or noncreative activities that can be performed by a team member or individual. Such activities are routine, teams are familiar with them, and they do not require much collaborative effort. Some are middle-of-the-road activities that may require some degree of intelligence for decision making. On the other hand, there are creative activities that require knowledge beyond one's own disciplines or areas of expertise. Depending upon the levels of activities and need for cooperation, the degree of intelligence required varies. This is where six levels of techniques, or methods required for a class of activity, are identified against the ``degree of creativity'' and ``needs for cooperation.

" The first of such techniques is ``network-based techniques,'' which can be performed by an individual team or a team-member, and where the activities are routine types. This is identified as level 0 in Figure 5. The next level is level 1. Over time, team members may have discovered heuristics in performing such tasks ± what work the best (best practices) and ± what to do in what situation (common systems). Such activities are still routine, though in order to reduce the lead-time, some level of intelligence, such as logic and heuristics-based methods, wouldbe useful. The need for cooperation increases as one moves away from simple problems to family of part ± geometry creation (level 2 activities). The use of variable-driven methods (such as parametric, variational or feature-based) are useful for level 2 to alleviate the boredom tasks of recreating the design details repeatedly, based on geometrical compatibility. There are problems ``beyond geometry'' whose solutions require non-geometrical knowledge, such as materials substitution, configuration designs, layout designs, knowledge of interaction problems, etc.

Network structures



Although there are various methods adopted for the networking of computer-based products they all possess certain common features. Each element must be equipped with a suitable interface associated with the LAN chosen and each element in the system must be connected into the network by means of wire or fibre-optic cabling to transmit the data from one station to another. Software is also necessary to handle all data transfer within the system correctly.

The physical arrangement of the elements or stations on the network are usually of a ‘star’ or ‘ring’ pattern. In the star-shaped network, the stations are

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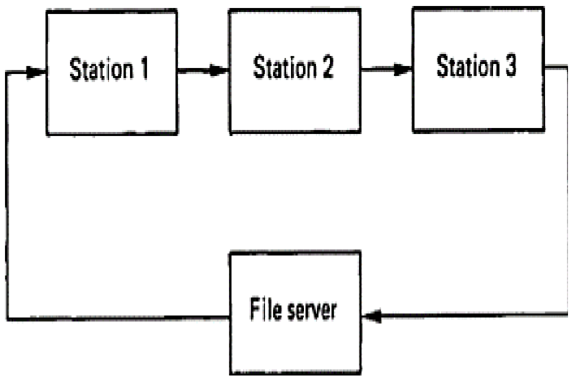
connected on a line parallel to one another and connected to a central computer referred to as the 'file server'. With this method, each user station must decide on whether data sent by the file server are for itself or another station. The cable length is limited in this system, but signal amplifiers can be used if required.

In the ring structure the file server master computer transmists data to the first station on the network. These data are checked, evaluated and passed on to the second station if not required. The data are hence transmitted from one station to another until the user for whom they are intended is found. Data can therefore be passed around great distances but the failure of any one station causes the system to break down.



Future of IIS

Perceived functions applicable to each division, or group, in the product's lifecycle will be formed as virtual agents of the intelligent system. These virtual agents will aid the CE teams in performing functions through an entire product's lifecycle with accelerated speed and greater accuracy. Typical functions may range from:

- Creating infrastructure (infrastructure agents); to
- Establishing standards (standardization agents); to
- Determining the product need or usage (need/usage agents); to
- Designing the product (design agents); to
- Analyzing the product (analysis agents); to
- Modifying an old design (product development agents); to
- Manufacturing (fabrication agents); to
- Production (production agents); and finally to
- Sales and marketing (distribution agents).

LITERATURE REVIEW

In the future, an engineer will perform a multitude of highly specialized tasks, each having more than one disciplinary flavor. Intelligent systems that contain both the products' specific functional knowledge (algorithmic and heuristic) and the processspecific facts pertaining to the product manufacturing operation will be used extensively throughout a corporation as shown in Figure 3. Figure 3 shows most of the manual tasks related to product design, engineering, and manufacturing processes computerized into a series of integrated product and process-design modules or knowledge-based tools to support a complete customer-focused manufacturing system. Both purchase order management and inventory management provide direct planned order conversion from MRP/master production schedule (MPS). Both MRP and MPS can be net change or regenerative with available-to-promise for

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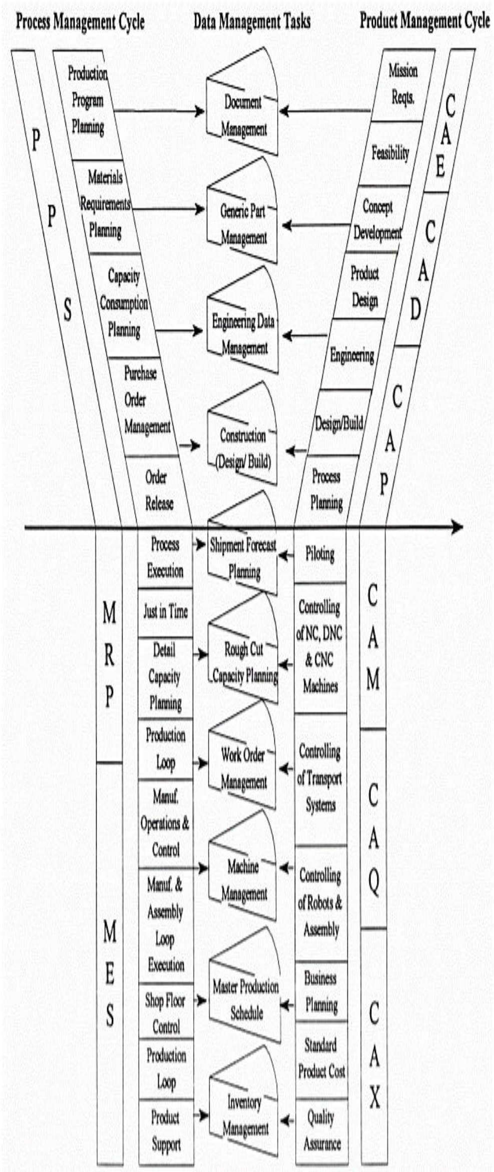
forecasted parts. Production plan forecast targets inventory balancing, smooth production curve, and seasonal product-line planning for both new product rollout and old product phase-outs.

METHODOLOGY



CONCLUSION

The paper describes what constitutes an intelligent information system (IIS). The most standard form of CIM commonly provides a battery of tools and systems ± computer-aided X-functions (CAXs) and computer-integrated X-functions (CIXs). Where X stands for a typical lifecycle function, such as design (CAD), engineering (CAE), process planning (CAPP),manufacturing (CAM), etc. CE and KM in IIS bring forth three missing links of CIM:

1. Intelligence: The intelligence comes from the virtual elements of CE teams.
2. Knowledge: The knowledge mainly comes from information modeling (digital models), and ``capturing lifecycle intent.'' 3 Value system: Value system deals with items such as culture, best industry practices for embedding a procedural discipline in CIM operations, and acceptable standards in enterprise-level communications.

It is observed working on a large CIM implementation, that the key to IIS success is understanding the obstacles to implementing CE in existing CIM processes and identifying opportunities for product, process and organization (PPO) improvements. The identification of improvement opportunities and the implementation of effective product development process control strategies can be facilitated by the systematic collection and monitoring of relevant in-process metrics.

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