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GRAPHICAL DESCRIPTION, CONTROL LOGIC DEVELOPMENT, SIMULATION DEVELOPMENT, AND ANIMATED DISPLAY OF MATERIAL HANDLING SYSTEMS

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ABSTRACT

We present a brief rationale for the material handling system design methodology being developed. During the presentation a film will be shown illustrating the development of a material handling systems design using interactive computer graphics and a subsequent animated display of a simulation of the system designed.

MATERIAL HANDLING SYSTEMS GRAPHICAL DESCRIPTION

In the early years of the decade it became clear that the physical components for the factory of the future existed or were in development. These physical components consist of computer controlled

1. machining and assembly stations
2. robots for localized material exchanges
3. material movement components (such as AGVS or car-on-track; ex. SI's CARTRAC)
4. material storage components (such as AS/RS or carousel storage).

The key and missing links were a) a design methodology for engineering specification of a system with the above listed physical components and b) a control systems architecture for operational control of a system with the above listed physical components.

The need for a control system architecture arose from the fact that a control system needs an interfacing of the computer controlled physical components and a systems traffic manager. The computers used for the above listed physical components range from Programmable Controllers (the basic language of which is a hangover from the relay logic of the 1940s) to micro computers with modern high-level language capability. Experience with interfacing found that the degree of interfacing complexity (and therefore systems control costs) is proportional to the square of the number of interfaces. This complexity results from a lack of an appropriate control systems architecture. In response to this problem SI Handling developed the SI Controller, a table driven systems traffic manager that allows interfacing of diverse computer controlled physical components. The SI Controller uses INTEL's 8086 processors and communications bus structure. The SI Controller has been used successfully in several applications and has adequately addressed the issue of interfacing complexity and a systems traffic manager.

There remains, however, the issue of a design methodology. The existing design methodology had several separate steps:

1. Pre-sales engineering specification (hand-drawn engineering schematic drawings) and manual cost evaluation.

2. Rough-cut bottleneck performance evaluation by an experienced engineer (in Artificial Intelligence terms, the knowledge expert) using paper and pencil calculations.

3. When appropriate (interpret--when the customer would pay for it), a performance evaluation by simulation using a simulation language (GPSS, SLAM, SIMSCRIPT, etc.).

4. Detailed encoding of the tables and logic for system control in the language of the computer used for System Control (often involved recoding the logic of the simulation program).

5. When appropriate (interpret--when the customer would pay for it), provision of a System Monitor.

The missing link in the above steps is the use of a common and computerized data base. Also there are two potentially hazardous transitions to steps 4 or 5 from steps 2 or 3. Of particular concern for those people in the simulation community is the transition from step 3 to step 4; to believe that one could assure that the encoding of special logic and tables in the System Control program mimics one-for-one the logic and tables embedded within a GPSS program, for example, is foolish, naive, and dangerous.

To address these concerns we have developed and implemented a set of graphics-based programs for the design of a restricted subset of material handling systems. The structure of this design methodology, in terms of functions and computers used, is shown in Figure 1. Except for System Control and Post-Sales Performance Evaluation which use the SI Controller's INTEL 8086, all other functions use the IBM PC.

In our presentation we will demonstrate the use of these graphics-based programs for the various functions.

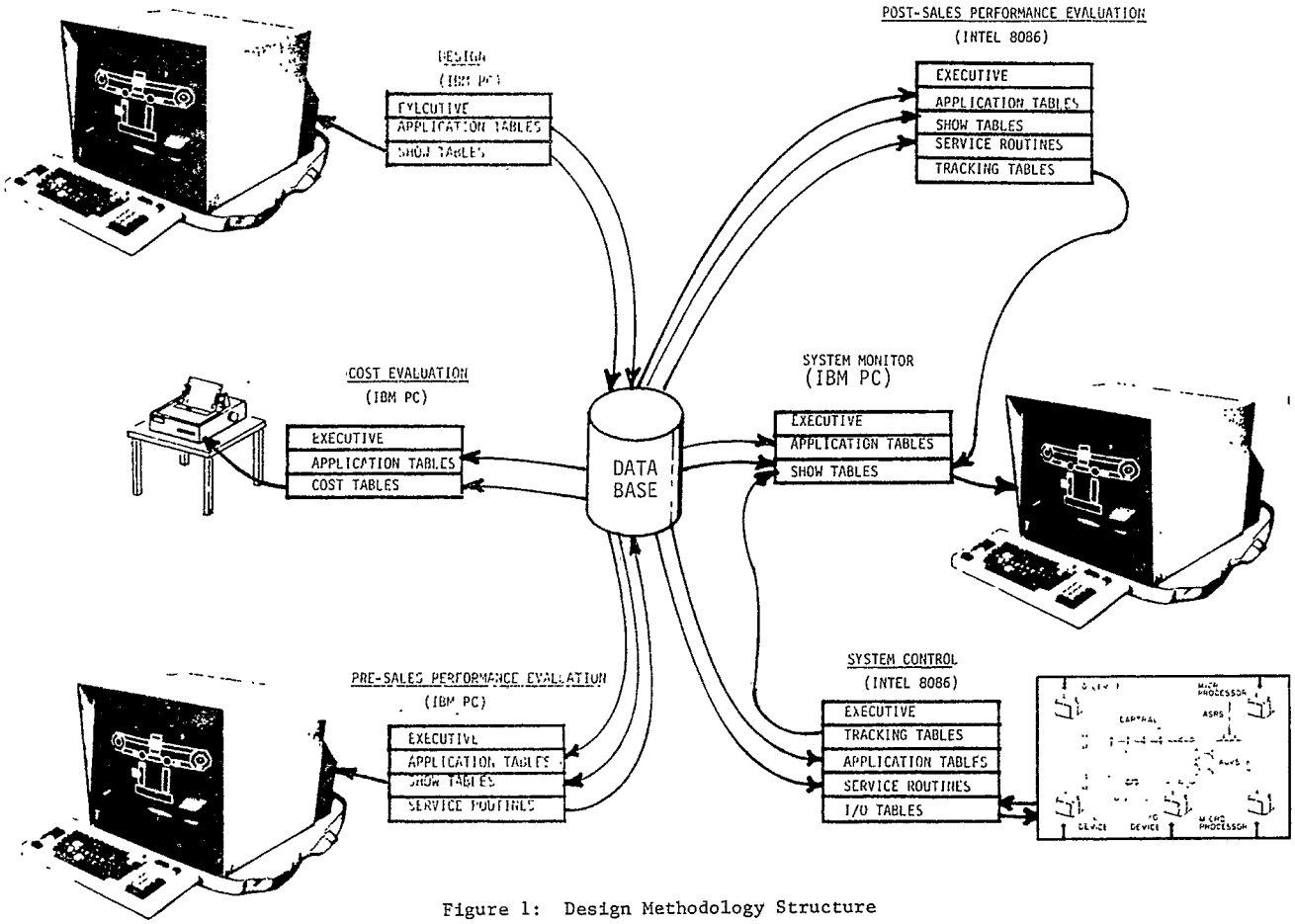

Figure 1: Design Methodology Structure