Appendix I

Notes Concerning the Hierarchy Structure For CIM Systems

It can be noted that in all of the installations made to date the chosen mode of implementation of the plant-wide system has been a hierarchy of separate computers.

Hierarchy systems have been favored as the implementation media to-date since they have the following characteristics important to their designers:

1. They follow the usual human management structure of the plant (see Table AI-I below).

2. They promote the Principle of Autonomy (i.e., responsibility can be delegated as low in the hierarchy as possible).

3. They promote the Principle of Locality (i.e., since plant units are usually widely distributed, but also usually comprise relatively self-contained units, distributed control can be readily applied).

4. They readily permit the distribution of plant-wide computing tasks to a multicomputer system due to the natural layering of control functions in the hierarchy [90,119].

5. The distribution just noted reduces the span of control responsibility of each control computer thus reducing its work load and the tasks of its implementation.

TABLE AI-I

DESIGN OF HIERARCHICAL CONTROL SYSTEMS

I. ALL CONTROL SYSTEMS REQUIRE MORE THAN ONE LEVEL, I.E., ALL ARE HIERARCHIES TO SOME DEGREE. THE DESIGN QUESTION IS: WHAT AND HOW MANY ARE THE LEVELS AND WHAT ARE THEIR ASSIGNED DUTIES?

II. ORGANIZATIONS AND COMPUTER ARCHITECTURES ARE HIERARCHICAL:

1. IN ORDER TO REDUCE THE EXCESSIVE INFORMATION LOADS WHICH IMPEDE THE DECISION MAKING PROCESS IN FLATTER ORGANIZATIONS.

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Table AI-I continued

2. TO KEEP THE SPAN OF CONTROL WITHIN HUMAN DECISION MAKING CAPABILITIES.

III. A FLATTER ORGANIZATION OR ARCHITECTURE IS FAVORED BECAUSE IT:

1. REDUCES THE "HUMAN" COMMUNICATION ERROR (NOT COMMUNICATING, MISUNDERSTANDING, FALSE INFORMATION).

2. SHORTENS THE RESPONSE TIME OF THE MANAGEMENT SYSTEM.

IV. WITH THE CIM ENVIRONMENT THE CAPABILITY OF RAPIDLY AND ACCURATELY TRANSFERRING DATA TO ALL FUNCTIONS FOR DECISION MAKING REDUCES THE NEED FOR EXCESSIVE SUPERVISORY LAYERS. IT DOES THIS BY:

1. PROVIDING TIMELY AND ACCURATE DATA AT CRITICAL LOCATIONS.

2. SOLVING DECISION LOGIC PROBLEMS, SUCH AS SCHEDULING PRODUCTION, EQUIPMENT DOWNTIME, ETC., THAT DO NOT NEED THE SUPER CAPABILITIES OF THE HUMAN BRAIN.

3. REDUCING RESPONSE TIME FOR LAN AND WAN CAPABILITIES. (LOCAL AND WIDE AREA NETWORKS.)

4. ELIMINATING HUMAN COMMUNICATION PROBLEMS (NOT COMMUNICATING, MISUNDERSTANDING OR FALSE INFORMATION).

5. MANIPULATING AND CONTROLLING VOLUMINOUS AMOUNTS OF DATA

FORMERLY CONTROLLED BY INDIVIDUALS.

V. THERE ARE SEVERAL FACTORS WHICH TEND TO INCREASE THE NUMBER OF LEVELS IN THE HIERARCHICAL STRUCTURE FOR THE CIM INFORMATION MANAGEMENT AND AUTOMATION CONFIGURATION. THESE ARE:

1. MODULARITY:

A. SCOPE

B. LOCALITY (PRINCIPLE OF LOCALITY)

2. THE NEED TO LIMIT THE COMPLEXITY OF INDIVIDUAL ENTITIES TO FACILITATE HUMAN COMPREHENSION AND COMPUTATIONAL TRACTABILITY.

3. PRINCIPLE OF AUTONOMY FOR THE APPLICATION FUNCTIONAL ENTITIES.

4. FLEXIBILITY TO PROMOTE THE INTRODUCTION OF NEW TECHNOLOGIES.

5. PHYSICAL LIMITATIONS OF FAN-IN AND FAN-OUT

A. PROCESSING CAPACITY

B. RESPONSE TIME

6. HIGHER HIERARCHICAL FUNCTIONS TEND TO FOCUS ON PLANNING (I.E., SCHEDULING), LOWER LEVELS ON EXECUTION.

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