CHARACTERIZATION OF THE PLACE OF THE HUMAN IN ENTERPRISE INTEGRATION

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ABSTRACT

The Purdue Enterprise Reference Architecture (PERA) has developed a unique methodology for determining the place of the Human in any particular enterprise. This methodology will be described in this paper to initiate discussion of this important topic in the ICEIMT97.

INTRODUCTION

It has been often shown that the human component is by far the major factor in any enterprise engineering endeavor [1]. However, essentially all enterprise integration architectures and methodologies today have avoided handling this important topic by considering the human as a resource only [2] or by assuming that the human achieves all necessary interface and communications capabilities with the rest of the enterprise [3]. The Purdue Enterprise Integration Reference Architecture has developed a unique method of approaching this problem and as a result can consider humans in all aspects of their involvement in the enterprise and the integration being considered.

THE SIMPLIFYING CONCEPTS OF ENTERPRISE INTEGRATION

The IFAC/IFIP Task Force on Architectures for Enterprise Integration was formed in 1990 by IFAC (The International Federation of Automatic Control) and IFIP (The International

Federation for Information Processing) to help solve the problems which had arisen in the previous decade in the manufacturing field. The Task Force was formed of a group of manufacturing engineers, computer scientists and information technology managers to study, compare, and evaluate the different available architectures in the open literature [4].

Several concepts emerged from the Task Force's studies which can greatly simplify and extend the work of enterprise integration as involved here. Some of them are:

1. While the early work in CIM was confined to the field of discrete manufacturing, it can readily be shown that the basic principles involved apply to any enterprise, regardless of its size and mission or any of the other such attributes involved. These are generally principles which apply to all aspects of the field of systems engineering. In addition, it is a mistake to confine the integration discussions to information and control systems alone. Often there are problems within the mission system (manufacturing or other customer product and service operations) whose solution would greatly ease the overall plant system problem (i.e., it must involve both information and mission).

2. No enterprise can long exist without a business or mission, i.e., it must produce a "product(s) or service(s)" desired by a "customer(s)." It usually must also produce these product(s) or service(s) in competition with other enterprises also vying for this same business.

3. There are only two basic classes of functions involved in operating any enterprise:

   a) Those involved in operating the "processes"[*] which result in producing the "product" which fulfills the enterprise's mission, i.e., the customer product or service business in which the enterprise is engaged. In the

[*] The use of quotation marks on several of the terms used here indicates they are defined in the most general manner possible in order to cover the extremely wide range of aims, methods and conditions covered.

manufacturing plant these would include all material and energy transformation type tasks and the movement and storage of the same materials, energy, goods in process and products.

b) Those involved in the "control" of the mission in an "optimal" manner to achieve the necessary economic or other gains which assure the viability or continued successful existence of the enterprise. These comprise the collection, storage and use (i.e., transformations) of information concerning the business processes in order to control them, i.e., to develop and apply necessary changes to the business processes to achieve and maintain their required "optimal" operation. Thus all planning, scheduling, control, data management, etc., functions.

4. Normally, information or data will undergo multiple transformations, i.e., many separate tasks (where a task defines each transformation) in fulfilling the information-handling requirements for an enterprise or CIM system. These transformations or tasks are usually successive operations forming sets of sequential and parallel networks.

5. The same is true of the material and energy transformation tasks for fulfilling the physical production or plant operations requirements for the enterprise.

6. In each case the networks involved can be combined, if desired, to achieve one major network of each type (Informational Transformations or Material and Energy Transformations, respectively), the totality of which defines the functionality of the enterprise or other business entity being considered (i.e., the totality of the information network, plus the manufacturing networks, both of which are developed separately but used conjointly).

7. The two networks interface in those tasks that develop operating variable state or status from the manufacturing processes (sensors) and those that deliver operational commands to the operational units (actuators and related devices). Except for these tasks and their related requirements, which do affect the other networks, each network can be developed independently of the other.

8. Initial functional analysis or general study of either or both classes of functions above can be carried out without knowledge or concern of how they will ultimately be implemented in the operating enterprise.

9. For many technological, economic, and social reasons, humans are involved in the implementation and execution of many business processes of all types in both classes above. Others, of course, may possibly be automated or mechanized. Thus there must be three classes of implemented tasks or business processes:

   a) Those of the information and control type which can be “automated” by computers or other “control” devices.

   b) Those of the mission tasks or business processes which can be automated by the “mission fulfillment” equipment.

   c) Those functions carried out by humans, whether of the control or mission fulfillment class.

   There must be a simple way of showing where and how the human fits in the enterprise and how the distribution of functions between humans and machines is accomplished.

10. All enterprises, of whatever type, follow a “life cycle” from their initial concept in the mind of an entrepreneur through a series of stages or phases comprising their

development, design, construction, operation and maintenance, refurbishment or obsolescence, and final disposal.

11. Not only does this life cycle apply to the enterprise but also to the enterprises' products as well. Thus, carried further, one enterprise can be the product of another. For example, a construction enterprise could build a manufacturing plant (enterprise) as its product. The manufacturing plant would then manufacture (produce) its own product, such as an automobile. The automobile also has its own life cycle, which goes through similar steps to those discussed here.

12. Once the integration of all of the informational and customer product and service functions of an enterprise have been properly planned (the Master Plan), the actual implementation of such an integration may be broken up into a series of coordinated projects, any and all of which are within the financial, physical, and economic capabilities of the enterprise, which can be carried out as these resources allow as long as the requirements of the Master Plan are followed. When these projects are completed, the integration desired will be complete.

13. All tasks will be defined in a modular fashion, along with their required interconnections, so they may be interchanged with other tasks that carry out similar functions but in a different manner.

14. Likewise, these latter tasks will also be implemented in a modular fashion, again permitting their later substitution by still other different methods of carrying out the same function. The choice of these implementation methods can be governed by independent design and optimization techniques as long as the task specifications are honored.

15. Provided the modular implementation just noted is used, the interconnections between these modules can be considered interfaces. If these interfaces are

specified and implemented using company, industry, national and/or internationally agreed upon standards, the interchange and substitution noted in Item 13 and 14 will be greatly facilitated.

16. By considering that manufacturing is a type of customer service, i.e., production of goods for purchase by the customer, and then expanding the definition of customer service to include all possible goods and services the enterprise may render to the customer, we can expand the Architecture to cover all possible types of enterprises. Thus the mission execution side of the Architecture would then represent the customer service rendered by any enterprise even if that service itself involved information.

These concepts then form the basis for developing the architecture and its associated methodology needed for carrying out enterprise integration engineering tasks as conceived by the Task Force and its members. It is Item 9 above that we wish to emphasize in this paper.

THE ENTERPRISE REFERENCE ARCHITECTURE

The universal applicability of the systems engineering concept of a life cycle (Item 6 above) allows one to develop a sketch or graphical model to illustrate most of the concepts and tasks involved in enterprise integration. This gives all the individuals involved a common and easy way for describing, planning, and carrying out all aspects of this very complex task in the easiest way possible. The other concepts listed establish the overall form and content of the resulting sketch. This sketch will be called an "architecture" since it describes the form or structure of the process of carrying out the life cycle of the enterprise or entity involved. Please see Figures 1-3 and 8 later in this paper. An architecture in its general sense is a drawing or discussion of the structure of something, generally physical such as a building, an electronic system, etc. These latter we will call Type 1 architecture. The architecture describing the form (structure and relationship) of the life cycle processes we will call Type 2. Only Type 2 architectures will be discussed in this paper.

DEVELOPMENT OF ONE FORM OF THE ARCHITECTURE

PERA AS AN EXAMPLE

The structure of PERA [5-7] will be used here to show how the needed reference architecture and methodology can be developed to satisfy the concepts needed. We will initially describe it to form the basis for our discussion of the place of the human to follow.

As noted in Concept 10, all enterprises throughout their lifetime fulfill a “life cycle.” Figure 1 shows the form of the architecture describing this as expressed by PERA. The life cycle proceeds from top to bottom of the figure, i.e., from initial identification of the project down through all intermediate phases to the final act of enterprise dissolution. The structure and form of the architecture will now be explained. (The numbering of nodes and boxes used here will be explained later.)

Figure 2 illustrates Concept 3 concerning the existence of two and only two classifications of functional tasks in the enterprise. It is well known by these authors that most computer scientists and information specialists prefer to separate information (databases and data handling) from control or decision theory. However, since “the only use for information is to effect control now or in the future,” we hold to our premise. This axiom my be considered a little farfetched when we consider history, but even here it holds if one believes, “history is to help us avoid the mistakes of the past.”

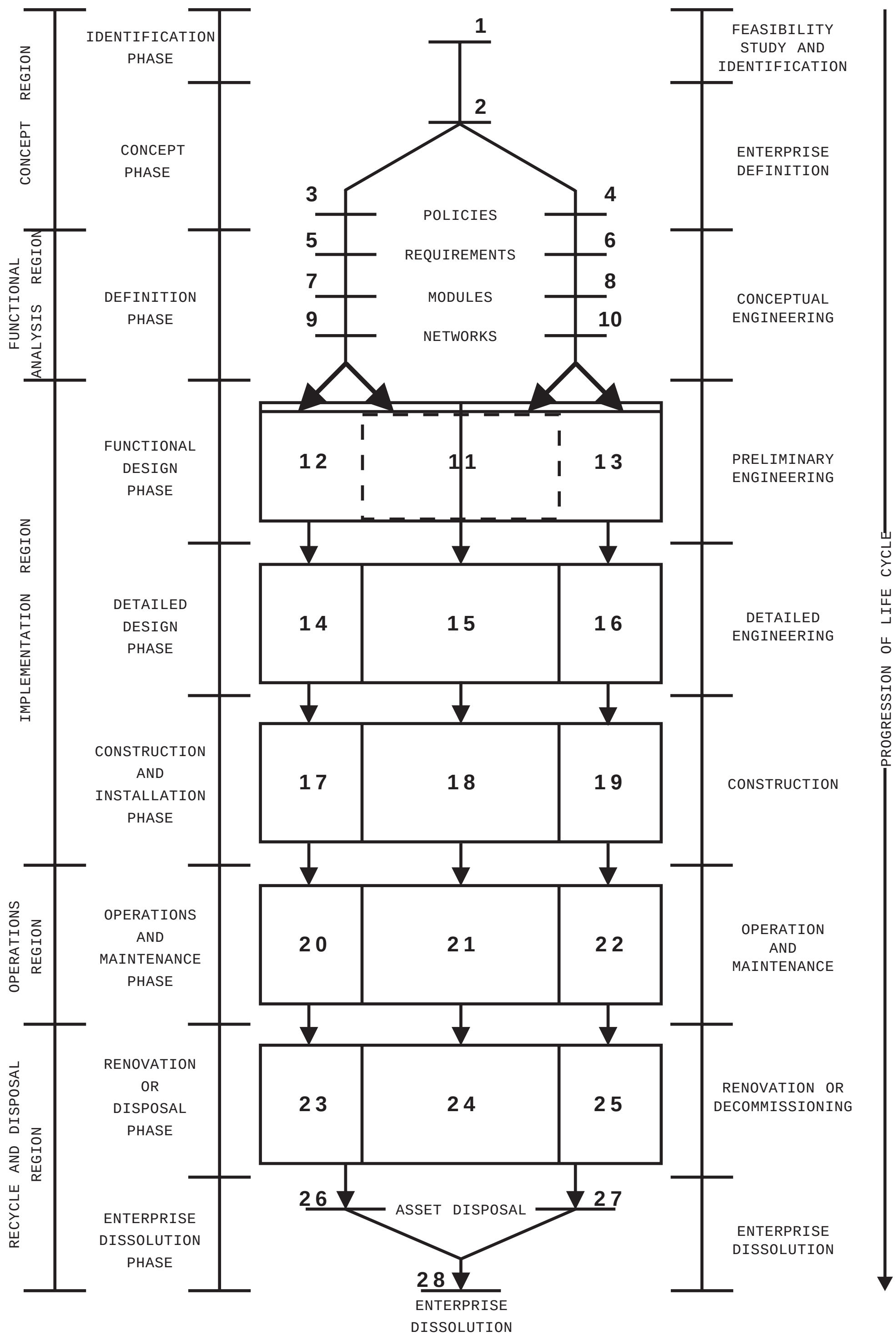


FIGURE 1. THE OVERALL FORM OF THE PURDUE REFERENCE ARCHITECTURE DIAGRAM SHOWING VARIOUS FORMS OF THE LIFE CYCLE

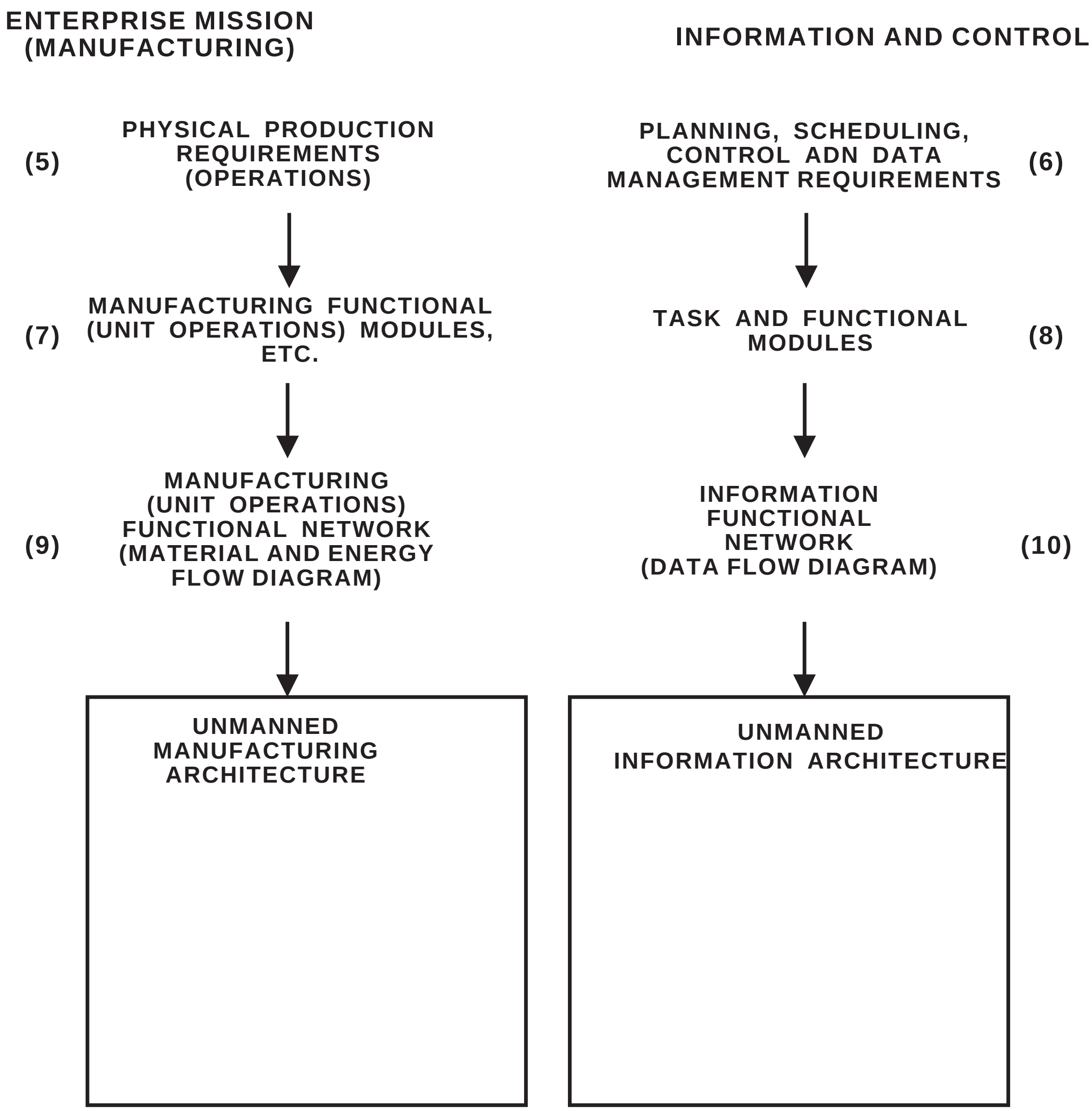


FIGURE 2. DEVELOPING THE RELATIONSHIPS OF THE SEVERAL SUB-ARCHITECTURES OF THE PURDUE ARCHITECTURE FOR MANUFACTURING SYSTEMS

Concepts 4-7 are illustrated by the progressing life history of Figure 2 showing requirements leading to the tasks necessary to fulfill them and these tasks then leading to functional networks. The networks (material and energy flow diagrams and data flow diagrams) are directly analogous to each other.

Figure 3 extends Figure 2 upwards (earlier in the life cycle and at a higher level in the company) to show the initial steps of the life cycle and the origin of the Requirements Level of Figure 2. Mission, Vision and Values (Node 2) gives management's desires for economic and other gains from the contemplated project. Policies (Nodes 3-4) show how management expects to gain the desired benefits. The resultant policies lead to the requirements on the system proposal which would ultimately enable those policies and management's expected benefits. Figure 4 shows that each node must be enriched from external sources to supply missing information from upper level sources as well as external requirements such as environmental, health and safety concerns, etc.

Figure 3 also shows the split of the two classes of functional tasks into three classes of implemented tasks to account for the place of the human worker in the enterprise. How this is determined will be discussed next.

Integration of Human and Organizational Factors

A singularly important contribution of the PERA Enterprise Integration Reference Architecture has been its presentation of a very simple yet again intuitively correct method for accounting for the place of the human worker in any automated system. The system works as listed in Table I and in the following discussion.

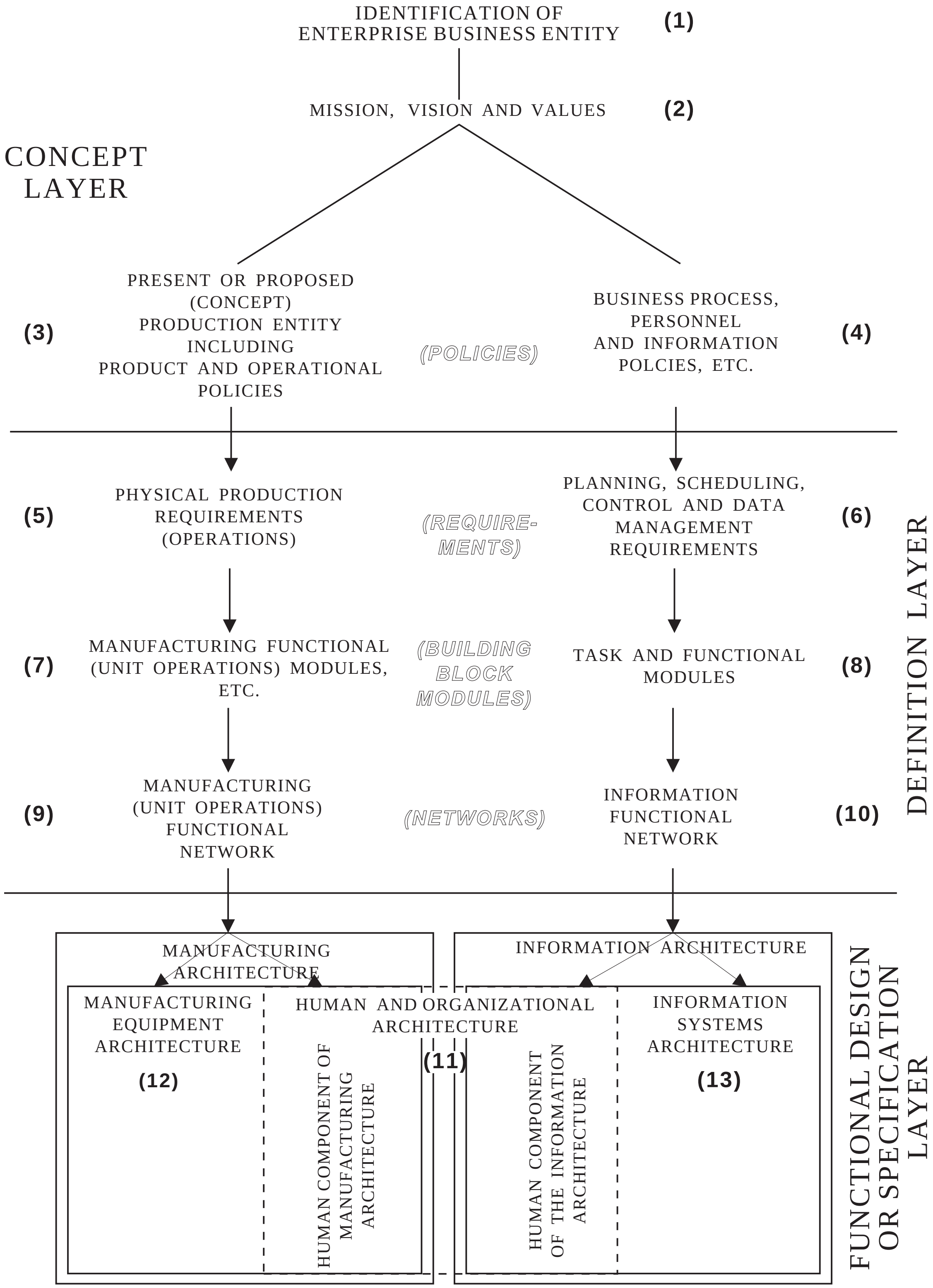


FIGURE 3. DEFINITION OF THE COMPONENTS OF THE CONCEPT AND DEFINITION LAYERS FOR THE MANUFACTURING CASE

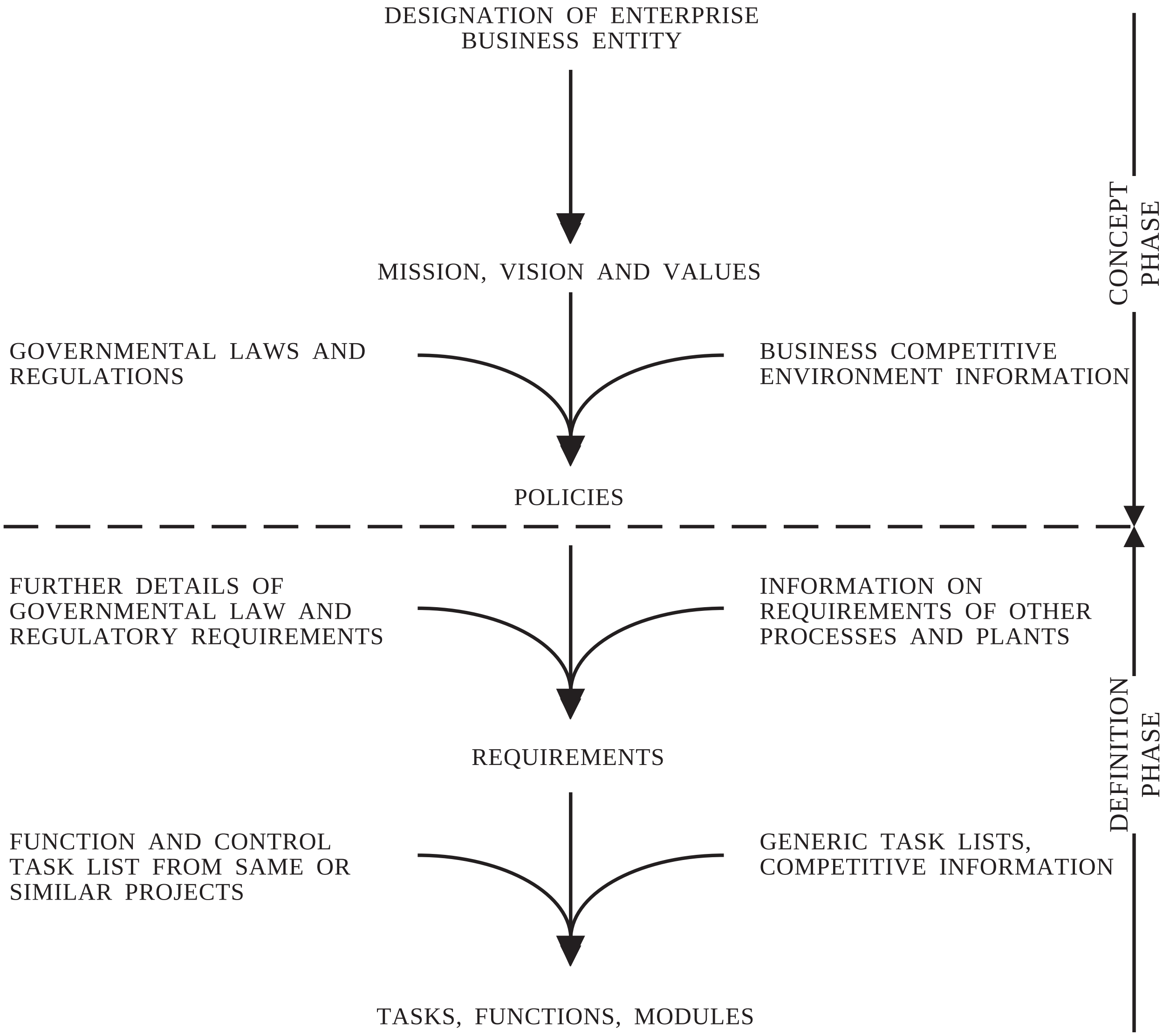


FIGURE 4. DEVELOPMENT OF ENTERPRISE REQUIREMENTS

TABLE I. SOME ADDITIONAL CONCEPTS OF THE PURDUE ENTERPRISE REFERENCE ARCHITECTURE THAT ESTABLISH THE PLACE OF THE HUMAN IN THE ENTERPRISE

1. The split of functions for implementation between humans and machines (on both the information and manufacturing sides of the diagram of Figure 2) forms the first definition of the implementation of the resulting manufacturing system. Because of the inclusion of humans, there must be three separate elements in the implementation scheme: the Information System Architecture, the Human and Organizational Architecture, and the Manufacturing Equipment Architecture.

2. Provided all timing, coordination, etc., requirements are fulfilled, it makes no difference functionally what functions are carried out by personnel versus machines *or* what organizational structure or human relations requirements are used.

3. The split in assignment of these functions (i.e., between humans and physical equipment) can be expressed on a diagram by an *Extent of Automation* line.

4. The ultimate split of functions between humans and machines is determined as much by political and human relations-based considerations as by technical ones.

5. The diagrams noted above can be extended to show the whole life history of the manufacturing enterprise.

6. All tasks in the Information Architecture can be considered as *control* in its very broadest sense, either immediately or at some future time. Likewise, all data collected and information generated is ultimately to effect *control* of the overall system being considered, either now or in the future.

   The only other use of this data and information is in the context of a historical record.

7. Likewise, all operations on the manufacturing side can be considered *conversions*, the transformation (chemical, mechanical, positional, etc.) of some quantity of material or energy.

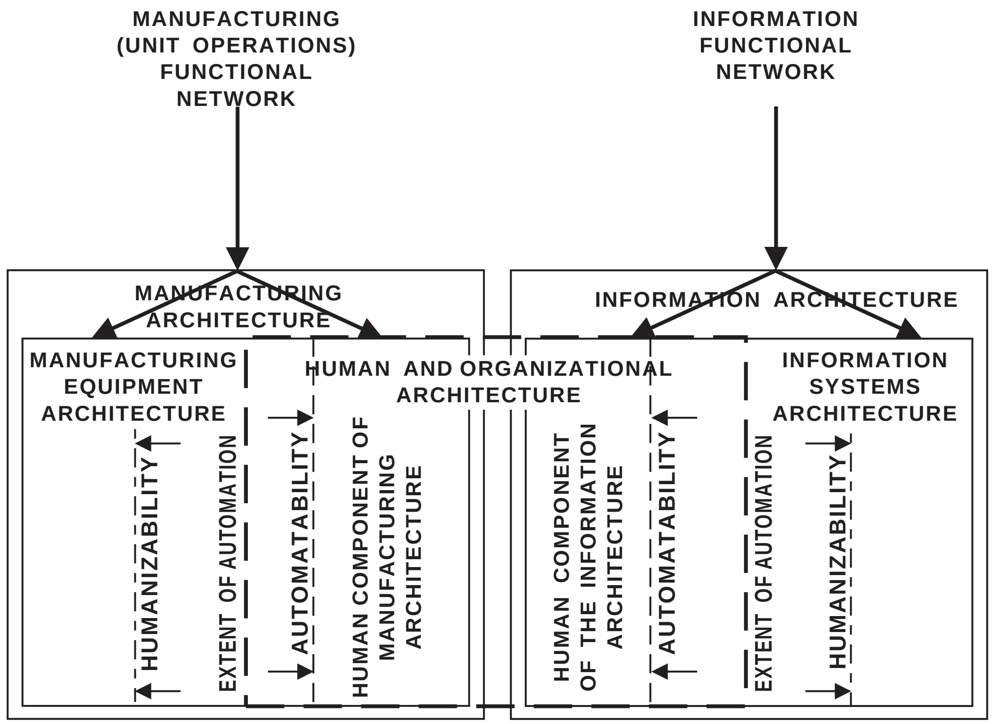


FIGURE 5. INTRODUCTION OF THE AUTOMATABILITY, HUMANIZABILITY AND EXTENT OF AUTOMATION LINES TO DEFINE THE THREE IMPLEMENTATION ARCHITECTURES

In order to show the true place of the human in the implementation of the enterprise functions, we need to assign the appropriate ones of these functions to the human element of the system. This can be done by considering the functional tasks as grouped in three boxes in the preliminary engineering or specification phase. These are separated by defining and placing sets of three dashed lines in the graphical architecture representation. This action will separate the two functional analysis streams into three as shown in Figure 5 and thus assign the tasks or functions involved to the appropriate boxes. The resulting columns of boxes then define the automated information tasks which become the Information Systems Architecture functions and the automated manufacturing tasks which become the Manufacturing Equipment Architecture functions. The remainder (non-automated) become the functions carried out by humans as the Human and Organizational Architecture,

The Automatability Line shows the absolute extent of pure technologies in their capability to actually automate the tasks and functions. It is limited by the fact that many tasks and functions require human innovation, etc., and cannot be automated with presently available technology.

The Humanizability Line (see Figure 5) shows the maximum extent to which humans can be used to actually implement the tasks and functions. It is limited by human abilities in speed of response, breadth of comprehension, range of vision, physical strength, etc.

Still a third line is presented which can be called the Extent of Automation Line (see Figure 5) which shows the actual degree of automation carried out or planned in the subject Enterprise Integration system. Therefore, it is the one which actually defines the boundary between the Human and Organizational Architecture and the Information Systems Architecture on the one hand, and the boundary between the Human and Organization Architecture and the Manufacturing Equipment Architecture on the other side.

The location of the Extent of Automation Line is influenced by

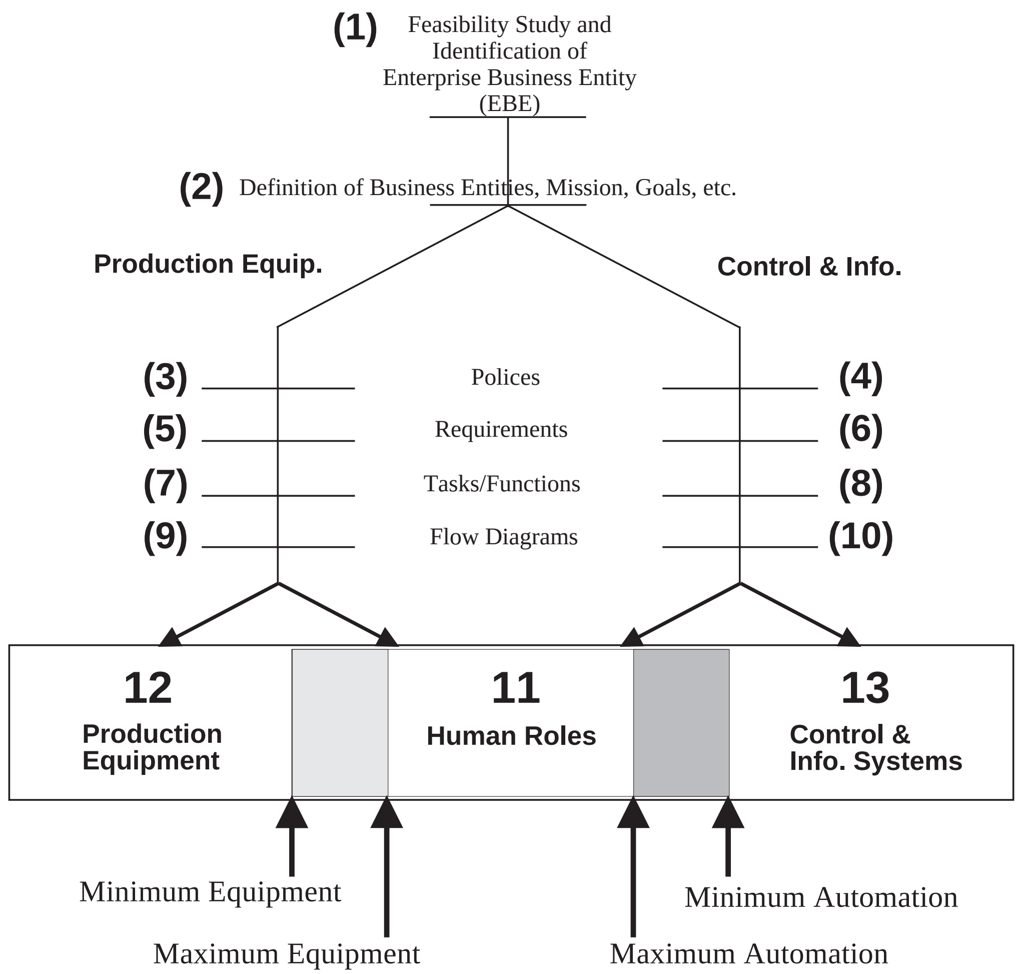
- Economic
- Political
- Social
    - -- Customs
    - -- Laws & Directives
    - -- Union Rules

as well as Technological factors.

The Automatability Line showing the limits of technology in achieving automation will always be outside of the Extent of Automation Line with respect to the automation actually installed (see Figure 5). That is, not all of the technological capacity for automation is ever utilized in any installation for various reasons. Thus, the Human and Organizational Architecture is larger (i.e., more tasks or functions) and the Information System and Manufacturing Equipment Architecture are smaller (less functions) than technological capability alone would allow or require.

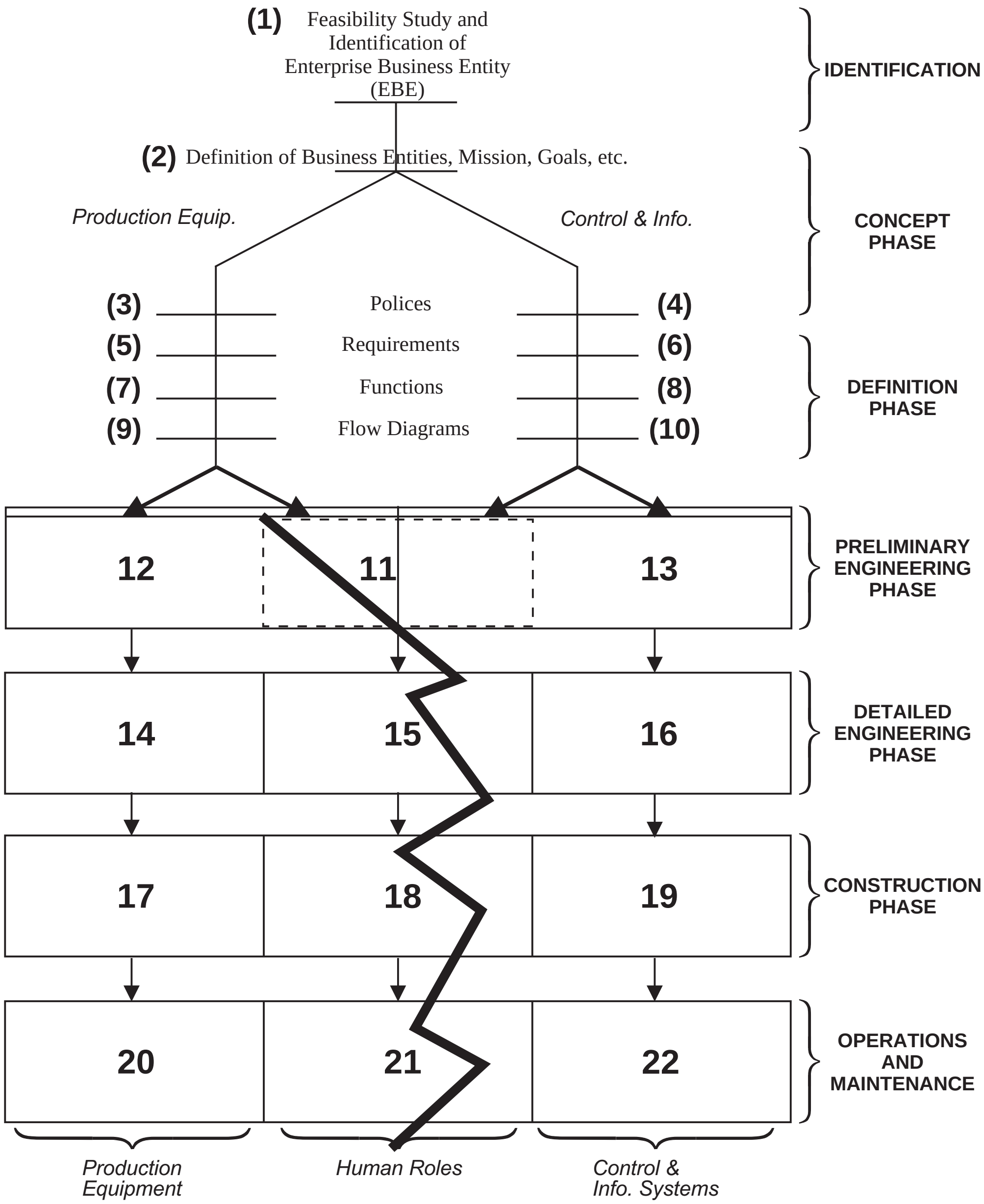
Note that for a completely automated plant as an extreme case, both the Automatability Line and the Extent of Automation Line would coalesce together and move to the left edge of the Information Architecture block and correspondingly to the right edge of the Manufacturing Architecture block. Therefore, the Human and Organizational Architecture would disappear and the Information Systems Architecture and the Manufacturing Equipment Architecture would coincide with the unmanned Information Architecture and the unmanned Manufacturing Architecture, respectively. This would then be the case illustrated by Figure 2.

Figures 6 and 7 continue our discussion of the place of the human in relation to automation and mechanization [7]. Figure 6 is another version of Figure 5 with the automatability and humanizability lines relabelled. Figure 7 points out the very incomplete state-of-the-art at present in terms of human factors and the present inadequacy of administrative assignment of the topics in many companies.



- Define Human & Organization Factors at Preliminary Engineering Phase
- Equipment, Automation and Human Roles are Interdependent
  - Equipment - A Conveyor vs. Manual Bag Dumping
  - Control - Automatic Sequencing vs. Manual Valve Actuation
- Must "Put Stake In Ground" for Downstream Design, i.e., Make Decisions Early and Keep Them.
- Policies Define Consistent Automation or Payback Goals

FIGURE 6. INTEGRATION OF HUMAN AND ORGANIZATIONAL FACTORS



- No "Human Factors" or Organization Design Discipline.
- Many Disciplines have Input (Controls, Process, Mech, etc.)
- Plant Operations Expertise, Training, etc., not yet Assigned to Specific Company Groups.

FIGURE 7. HUMAN AND ORGANIZATIONAL RESPONSIBILITY IS SPLIT

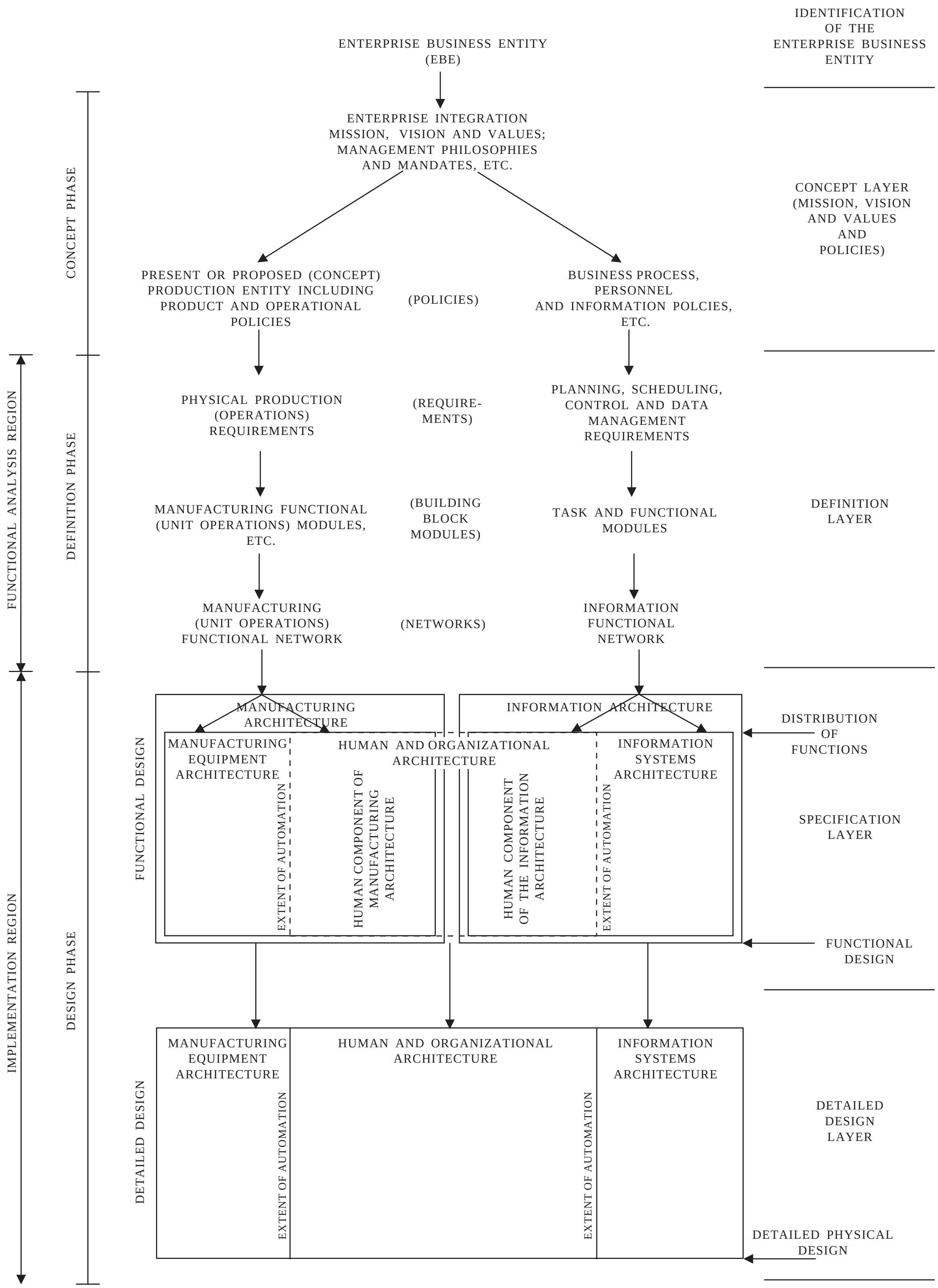


FIGURE 8. DEVELOPMENT OF AN ENTERPRISE INTEGRATION PROGRAM AS SHOWN BY THE PURDUE ARCHITECTURE (PHASES AND LAYERS OF THE PROGRAM)

FIGURE 8 (CONT). THE LATER PHASES IN ENTERPRISE INTEGRATION SYSTEM EVOLUTION AND THEIR ACTIVITIES IN RELATION TO THE PURDUE ARCHITECTURE

Figure 8 summarizes our discussion of PERA as an example Enterprise Integration Architecture by showing the overall architectures and life cycle of the enterprise development program down to and including the operations phase. Note that the problem of analysis and disposal or renovation of the obsolete plant as shown in Figure 1 could also be included here for completeness if desired. The purpose here is to show how the architecture can be used to describe each of the tasks carried out at each phase, node and box represented in the architecture and their relationship to each other. The amount of detail shown is a function of the space available and the purpose to which a particular diagram is put.

The numbering of the nodes and boxes of Figures 1, 6, and 7, in conjunction with Table II, shows the meaning of each of the boxes of the architecture diagram to present the operational concerns and available tools for carrying out each of the tasks listed in Figure 8.

TABLE II. AREAS OF INTEREST ON THE ARCHITECTURE FRAMEWORK FOR DISCUSSING DEVELOPMENT AND IMPLEMENTATION AIDS FOR PROGRAMS AND ENTERPRISE STUDIES (REFER TO FIGURE 1)

Area	Subject of Concern	Types of Aids Available
1.	Identification of Enterprise Business Entity	Feasibility studies, potential gains and benefits vs. costs of proposed business entities to undergo enterprise integration programs. Identification of chosen enterprise.
2.	Mission, Vision, and Values of the Enterprise, operational philosophies, mandates, etc.	Example sets of Mission, Vision and Values expressions from company annual reports or the basic documents themselves. These are valuable to the extent that they are generic.
3.	Operational Policies and goals related to the customer Product and Service or Manufacturing goals and objectives, etc., of the Enterprise	Example scopes of the tasks for development and operation of specific processes and plants or other corresponding Customer Product or Service Operations; if for the same process or type of plant, may be directly used or otherwise will be used as an example of types of requirements needed. (continue)

TABLE II (CONT.). AREAS OF INTEREST ON THE ARCHITECTURE FRAMEWORK FOR DISCUSSING DEVELOPMENT AND IMPLEMENTATION AIDS FOR PROGRAMS AND ENTERPRISE STUDIES (REFER TO FIGURE 1)

Area	Subject of Concern	Types of Aids Available
4.	Operational policies related to the Information goals and objectives, etc., of the Enterprise	Generic lists of: Policies and requirements related to such topics as: control capabilities; degrees of performance of processes and equipment; adherence to classes of regulations and laws (environmental, human relations, safety, etc.); compliance in the above to a degree of good community behavior (good neighbor, citizen of the world, etc.); quality, productivity, and economic return goals; etc.
5.	Requirements to be fulfilled in carrying out the Customer Product and Service or Manufacturing related Policies of an Enterprise	Example sets of operational requirements for specific processes and process plants or other corresponding Customer Product or Service Operation; would include general safety requirements, fire rules, etc., that will influence plant design and process and equipment selection later in the program development; OSHA regulations and Fire Safety Underwriters rules. (continue)

TABLE II (CONT.). AREAS OF INTEREST ON THE ARCHITECTURE FRAMEWORK FOR DISCUSSING DEVELOPMENT AND IMPLEMENTATION AIDS FOR PROGRAMS AND ENTERPRISE STUDIES (REFER TO FIGURE 1)

Area	Subject of Concern	Types of Aids Available
6.	Requirements to be fulfilled in carrying out the Information Policies of the Enterprise	Generic lists of requirements necessary to carry out the policies listed in Area 4, probably in the form of scopes of the macrofunctions to be listed in Area 8.
7.	Sets of Tasks, Function Modules and Macrofunction Modules required to carry out the Requirements of the Manufacturing or Customer Product and Service Mission of the Enterprise	Lists of generic unit process operations of chemical engineering, or, of the manufacturing features from group technology for the discrete products industry; corresponding requirements for other types of Customer Product or Service Operations.
8.	Sets of Tasks, Function Modules, and Macrofunction Modules required to carry out the Requirements of the Information or Mission Support side of the Functional Analysis	Generic lists of Control and Information Tasks, Function Modules, and Macrofunctions. (continue)

TABLE II (CONT.). AREAS OF INTEREST ON THE ARCHITECTURE FRAMEWORK FOR DISCUSSING DEVELOPMENT AND IMPLEMENTATION AIDS FOR PROGRAMS AND ENTERPRISE STUDIES (REFER TO FIGURE 1)

Area	Subject of Concern	Types of Aids Available
9.	Process flow diagrams showing the connectivity of the Tasks, Function Modules, and Macrofunctions of the Manufacturing or Customer Product and Service processes involved	Example of flow diagrams for commonly available processes showing material and energy balances and example process operating procedures are likely types of aids here; corresponding requirements for other types of Customer Product or Service Operations.
10.	Connectivity diagrams of the Tasks, Function Modules, and Macrofunction Modules of the Information or Mission Support Activities probably in the form of data flow diagrams or related modeling methods	Data flow diagram techniques; the generic data flow diagram of the Purdue Reference Model.
11.	Functional Design of the Human and Organizational Architecture. Establishment of the Automatability, Humanizabiltiy and Extent of Automation Lines	Example lists of generally required personnel tasks; auditing methods for skill level determination (required vs. available); methods for cultural status assessment and correction. (continue)

TABLE II (CONT.). AREAS OF INTEREST ON THE ARCHITECTURE FRAMEWORK FOR DISCUSSING DEVELOPMENT AND IMPLEMENTATION AIDS FOR PROGRAMS AND ENTERPRISE STUDIES (REFER TO FIGURE 1)

Area	Subject of Concern	Types of Aids Available
12.	Functional Design of the Manufacturing or Customer Product and Service Equipment Architecture	Example specifications of process equipment to be required; P and I, Ds (piping and instrumentation diagrams) indicating control systems capabilities necessary to accomplish suggested task assignments and degree of automation indicated, obtained from the current literature; computer-based process plant layout and design optimization programs available from a wide variety of vendors for almost any industry, corresponding examples from other types of Customer Product or Service Operations.
13.	Functional Design of the Information Systems Architecture	Generic representations of typical control and information systems; functional design aids; lists of sensors, actuators, control functions for particular process equipment examples; data base design techniques; entity relationship diagrams; the Purdue Scheduling and Control Hierarchy [15]; example hardware architectures from various vendors; networked communications are also very important. (continue)

TABLE II (CONT.). AREAS OF INTEREST ON THE ARCHITECTURE FRAMEWORK FOR DISCUSSING DEVELOPMENT AND IMPLEMENTATION AIDS FOR PROGRAMS AND ENTERPRISE STUDIES (REFER TO FIGURE 1)

Area	Subject of Concern	Types of Aids Available
14.	Detailed Design of components, processes, and equipment of the Manufacturing or Customer Product and Service Equipment Architecture	Detailed design techniques for physical processes and equipment from the major handbooks of the various engineering fields; computerized versions of these design methods available from a wide variety of software vendors; corresponding examples from other types of Customer Product or Service Operations.
15.	Detailed Design of the task assignments, skills development training courses, and organizations of the Human and Organizational Architecture	Example lesson plans and syllabi for necessary training courses; example organizational charts for equivalent groups in terms of numbers of people, skill levels and tasks required; team building.
16.	Detailed Design of the equipment and software of the Information Systems Architecture	Computer control systems components selection aids from control system vendors; configuration software packages from these same vendors; software project management techniques.
17.	Construction, check-out, and commissioning of the equipment and processes of the Manufacturing Equipment Architecture	Project management techniques such as critical path method. These and related techniques are readily available as computerized project management aids from a wide variety of vendors. (continue)

TABLE II (CONT.). AREAS OF INTEREST ON THE ARCHITECTURE FRAMEWORK FOR DISCUSSING DEVELOPMENT AND IMPLEMENTATION AIDS FOR PROGRAMS AND ENTERPRISE STUDIES (REFER TO FIGURE 1)

Area	Subject of Concern	Types of Aids Available
18.	Implementation of organizational development training courses, and on-line skill practice for the Human and Organizational Architecture	Continuation of the work under Area 15 in terms of training and staffing of the members of the Human and Organizational Architecture
19.	Construction, check-out, and commissioning of the equipment and software of the Information Systems Architecture	Project management tools as noted under Area 17.
20.	Continued improvement of process and equipment operating conditions to increase quality and productivity and to reduce costs involved for the Manufacturing or Customer Product and Service Equipment Architecture	Continued improvement of the operation of the plant and its associated manufacturing system involving such techniques as Statistical Quality Control, Statistical Process Control, Total Quality Management, and other related techniques.
21.	Continued organizational development and skill and human relations development training of the Human and Organizational Architecture	Tasks here are continued improvement of workers' skills and training of replacement workers; same aids as for Areas 11, 15, and 18 prevail. (continue)

TABLE II (CONT.). AREAS OF INTEREST ON THE ARCHITECTURE FRAMEWORK FOR DISCUSSING DEVELOPMENT AND IMPLEMENTATION AIDS FOR PROGRAMS AND ENTERPRISE STUDIES (REFER TO FIGURE 1)

Area	Subject of Concern	Types of Aids Available
22.	Operating of the Information and Control System of the Information Systems Architecture including its continued improvement	Continued improvement of the operation of the plant and its associated control system involving such techniques and aids available as noted under Area 20 above.
23.	Review of mission for enterprise. Planning for revamping and redesign of customer product and service production equipment	Project management tools; auditing software; renovation and recycle techniques.
24.	Review of mission of enterprise. Planning for revamping and redesign of organizational architecture as mission changes; retraining of personnel as new tasks and new skills require	Same aids as for Areas 11, 15 and 18.
25.	Review of mission for enterprise. Planning for revamping and redesign of information systems; preservation and transfer of system information as needed	Project management tools; auditing software; information management tools and techniques.

(continue)

TABLE II (CONT.). AREAS OF INTEREST ON THE ARCHITECTURE FRAMEWORK FOR DISCUSSING DEVELOPMENT AND IMPLEMENTATION AIDS FOR PROGRAMS AND ENTERPRISE STUDIES (REFER TO FIGURE 1)

Area	Subject of Concern	Types of Aids Available
26.	If decision is made to scrap Customer Product and Service Plant and Equipment, dispose of physical equipment in ways which optimize economics without major injury to environment	
27.	Dispose of Information Systems and Control equipment in ways which are benign to the environment while pursing best related economics	
28.	Take necessary legal steps to dissolve charter of former enterprise. Complete reassignment of any remaining personnel	

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