Building an Organizational Learning Environment

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Abstract

This paper highlights the authors' attempts to develop a software environment to help analysts (1) improve their understanding of the dynamics of the energy system and (2) build confidence in a complex, highly defined system dynamics model of energy supply and demand. The envisioned organizational learning environment has at its center a human interface design from which the user controls simulations, exercises, guided tours, model modifications, experiments, etc. While efforts to date have focused upon developing a micro-computer based system, the learning environment will be extended to workshops in the future.

Any energy simulation model can be intimidating to users who lack a sufficient understanding of supply/demand concepts and knowledge of the computer language employed. The situation becomes more complicated as the complexity of the simulation model increases and new operational (or system performance) concepts are introduced.

We provide a brief description of an energy supply/demand simulation model, ENERGY 2020, that Central Maine Power uses for demand forecasting. Developed by George Backus and Jeffrey Amlin, the long-term energy policy model is used by analysts for both utility-level planning as well as state energy policy analysis. The model is coded in PROMULA for IBM-compatible personal computers.

The problem is to create a means by which new users can explore and understand the complexity of the energy system (the ENERGY 2020 Model) in a structured and nonintimidating manner. The goal is to bring the users to a higher level of understanding, mastery, and ownership of the model.

Background

Recent thinking in management theory maintains that, in the future, an organization's competitive advantage, and possibly its survival, will lie increasingly in its ability to assemble products of smaller and smaller lot size according to changing customer preferences (Peters, 1990; Quinn, 1990; Stata, 1989). As a result, many manufacturing firms and service organizations, like Central Maine Power Company (CMP), are adopting total quality concepts: focus on the customer, constant improvement, management by facts, and respect for people (Collier, 1990). In this paper we focus on the demands that this new way of doing business places on the organization's learning ability and how the learning process might be enhanced by using simulation models to cope with emerging and unexpected customer needs and expectations.

Seen from an historical perspective, smaller lot size, market segmentation and a focus on customer needs shifts the control over what gets produced to the customer. In effect, the customer is the new product designer. In the past, a typical firm chose which product-related concerns it wished to address and trained its employees and agents to address those concerns. No longer can a viable organization decide what, how much, and for whom. In today's market, customers decide product-related issues. Hence, the firm must teach its employees and agents how to address the concerns and needs selected and prioritized by the customer; this is a learning process.

Thus, we see a shift in emphasis from training (which is dealing with problems where the answer is already known) to learning (which is dealing with problems where the answer is not known). Organizations need to teach problem solving skills which can be applied swiftly and locally without going up and down the various authority chains, without strict adherence to manuals which have a so-called best answer to commonly encountered situations. The problem, of course, with "best" answers is that employees often try to reshape the customer's problem into one that is answered in the manual rather than trying to address the customer's real concern.

This shift in emphasis has significant implications for traditional functions within electric utilities. Figure 1 provides an overly simplistic picture of the environment in which utilities used to operate. The load forecaster would translate expected economic growth into an electricity demand forecast. Supply planners would optimize and select the best construction plan for the utility to pursue. If regulators approved, construction would precede and a new generating unit would be operating in five or six years. The electric utility industry was the paradigm of a natural monopoly that focussed its attention on producing low cost power. It knew what the best answer was.

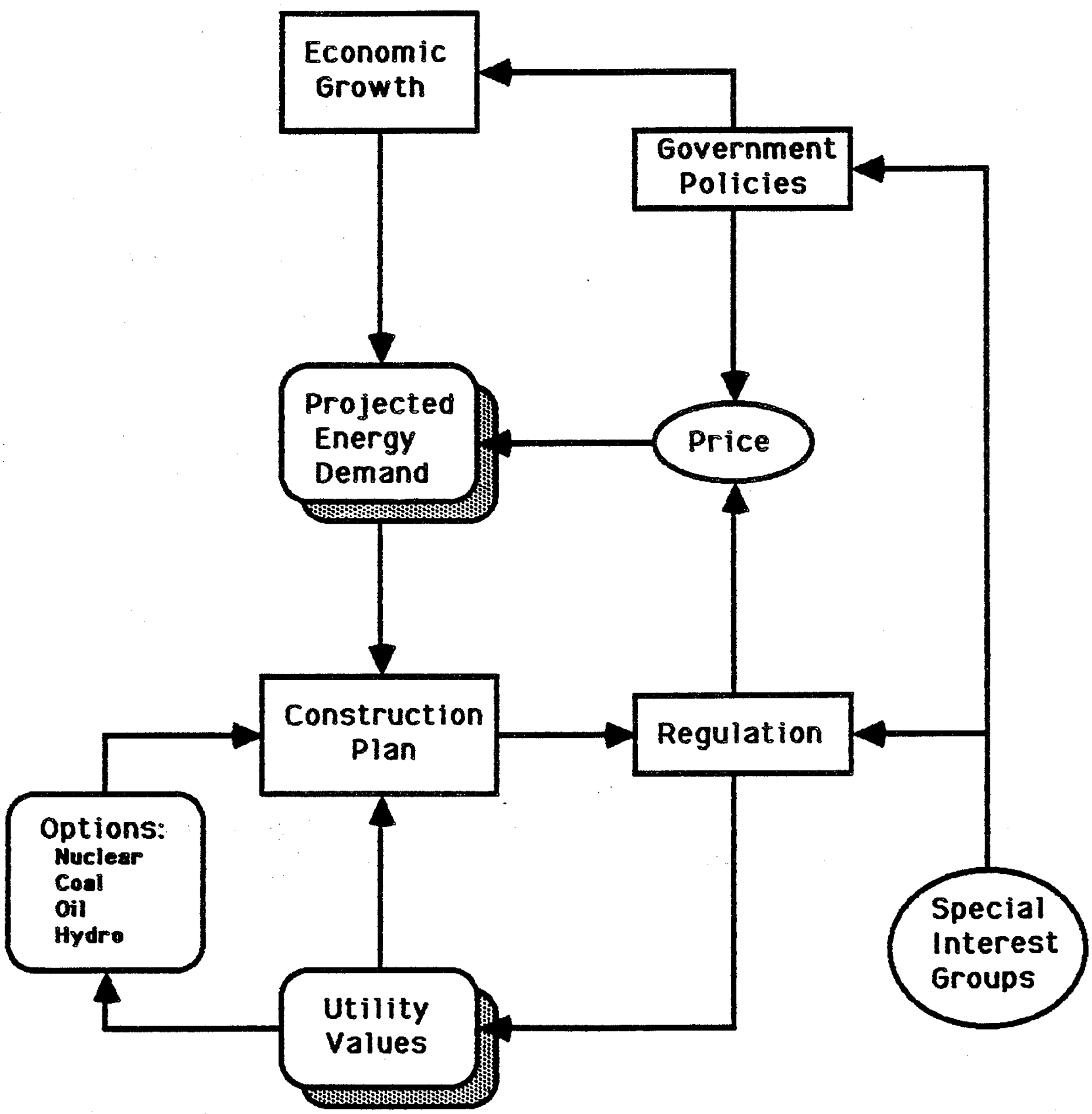

Figure 1. The Way We Were

However, a number of the industry's solutions proved to be neither correct nor desirable to regulators, special interest groups and energy policy makers. Figure 2 highlights the current environment in which CMP operates. Note that the load forecaster now is concerned with projecting energy service (heat, light, motor drive) and that the supply planner recommends the best resource plan for providing that service. Company sponsored energy management (or conservation) programs are treated as a resource that can provide energy service through improved efficiency (without requiring new capacity). Other resources, which often are preferred to new construction, are purchases of power from cogenerators, small power producers and other utilities.

One possible future in which electric utilities will operate is depicted in Figure 3. In this scenario, the utility is seen as successfully incorporating total quality concepts into its daily business practices and long-term planning process. The Company's focus is on the customer's specification of the product. As Shoji Shiba has put it,

> I see the next step in TQ as being a "philosophy-in and out" definition of quality. The definition is no longer determinable by a one-way flow. Corporations can now influence consumers, governments, and other corporations to influence what "quality" means, both what a quality product is, and what a quality corporation's civic duties are. That's a "philosophy out" definition of quality. Many different stake holders interact to determine what quality is and how a corporation and its products are performing. "Quality" equals what fits well in the consumer's lives, the politics of the country, the ecology, and so on. Moreover, companies should be able to monitor and forecast shifts in societal values and needs, and respond to them by changing business practices. That's a "philosophy-in" definition of quality. Finally, on the outside, a more permanent set of ethics drives the process of value change in society. (Graham, 1989, 10.)

CMP's current modeling capabilities are germane to the environment of Figure 2 and anticipate some of the needs envisioned in Figure 3. However, it cannot be understated that the transition from the relatively simple modeling efforts (appropriate for the environment of Figure 1) has not been an easy one. The added complexity of the current generation of energy forecasting models as well as the shift in emphasis to energy service demand creates a situation in which new model users can be overwhelmed. The technical documentation of the ENERGY 2020 Model, for example, exceeds 1,000 pages (Backus, 1987). The computer code approaches 10,000 lines.

Further, since the model is built to allow exploration of problems and policy options which were not even thought of when

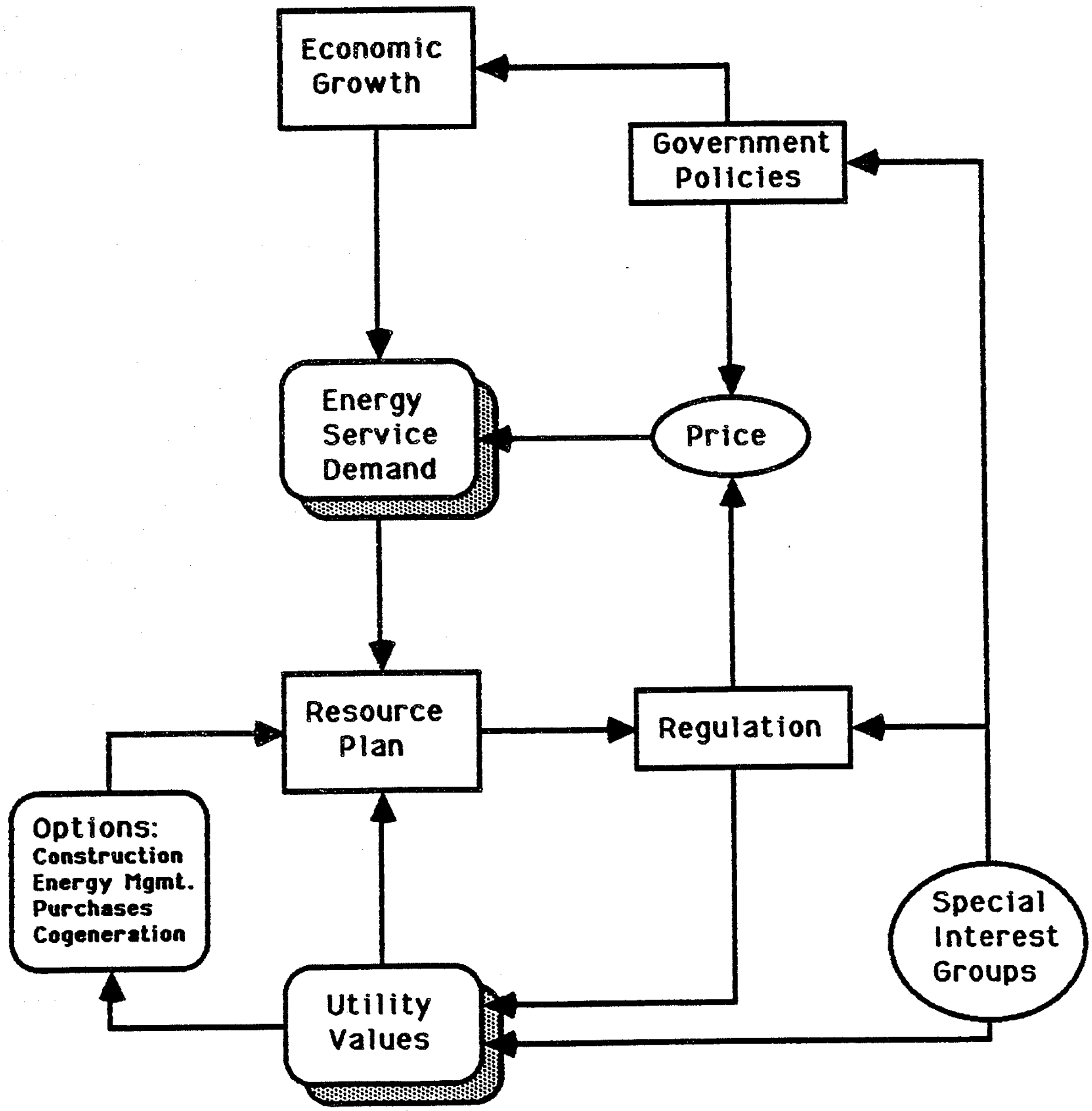

Figure 2. The Way We Are Now

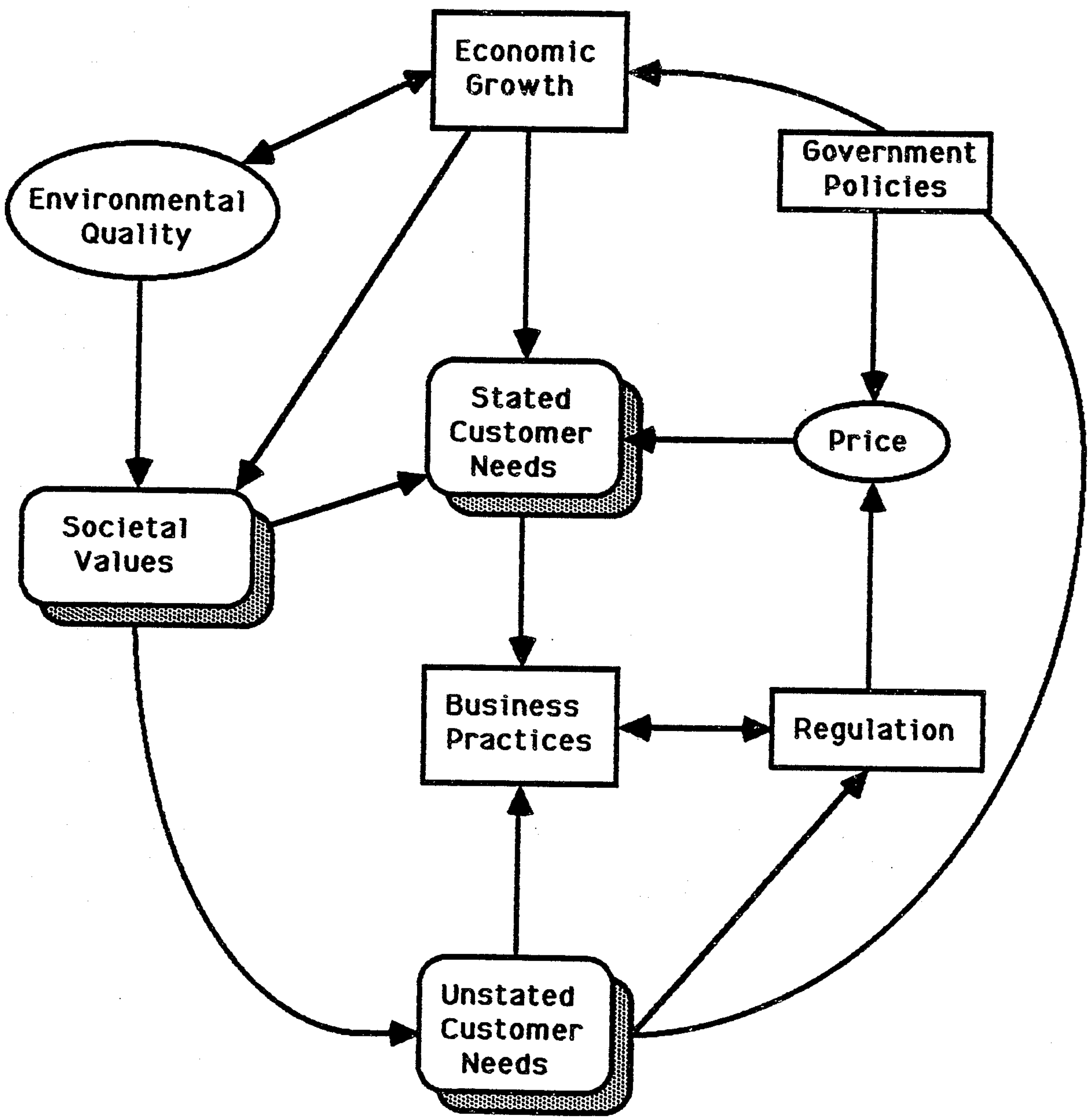

Figure 3. The Way We Will Be ?

the model was commissioned, it is not in the form of an intelligent decision tree, but rather a strategic rehearsal tool. This places a heavy burden on the model user to own the model, rather than merely consult it.

Complex and rich models, however, are not known for their accessibility. CMP, therefore, had to find ways to motivate model users to seek access to and control over the model (in terms of understanding, not passwords).

If one tries to teach anything, one needs to assemble (1) expert knowledge about the domain to be taught, (2) develop a model of the learner's knowledge as he or she interacts with the domain, (3) employ a tutorial strategy to design, regulate, and adjust the instructional interaction between learner and expert domain, and (4) design a communication strategy through which the first three are delivered. CMP has the expert knowledge in the form of the ENERGY 2020 Model. So far, it lacks the other three components.

Possible Solutions

One approach might be to add the missing components to ENERGY 2020, i.e., incorporate within the model a tutorial strategy, a dynamically adjustable interface that interrogates the user's knowledge both obtrusively and unobtrusively. A "clickable" interface to the simulation model running in the background is conceivable. A user would be confronted by a simple conceptual map (like Figure 2) of the underlying causal structure of the energy supply/demand system. Clicking on the "Service Energy Demand" box would present the user with a menu of methodology choices; for example, econometric, judgemental or causal/descriptive. Selecting the latter option, the user would be presented a visualization of the relevant structure of equations (see Figure 4). The user, then, could proceed to make further choices or gain more understanding of the underlying theory involved. Ideally, the user could obtain help and/or expert guidance in real time from within the software environment.

To a limited extent and with limited success, CMP has attempted to pursue this path using PROMULA and the IBM-compatiable personal computer (Davulis, 1989). Our experience suggests that neither PROMULA nor the IBM-platform provides a friendly and flexible interface for inexperienced users. The Macintosh operating system together with a combination of STELLA, STELLA Stack and/or MicroWorld Explorer appear to offer more potential.

Another alternative is to rely much more on the resources of the learners themselves in guided and structured explorations of the domain. While the guides would be humans, the learner's experience would be supported by technological tools (documentation, workbooks, software). Again, to a limited extent and with limited success, CMP developed a workbook centered round a series of simple STELLA models (Golüke), 1989).

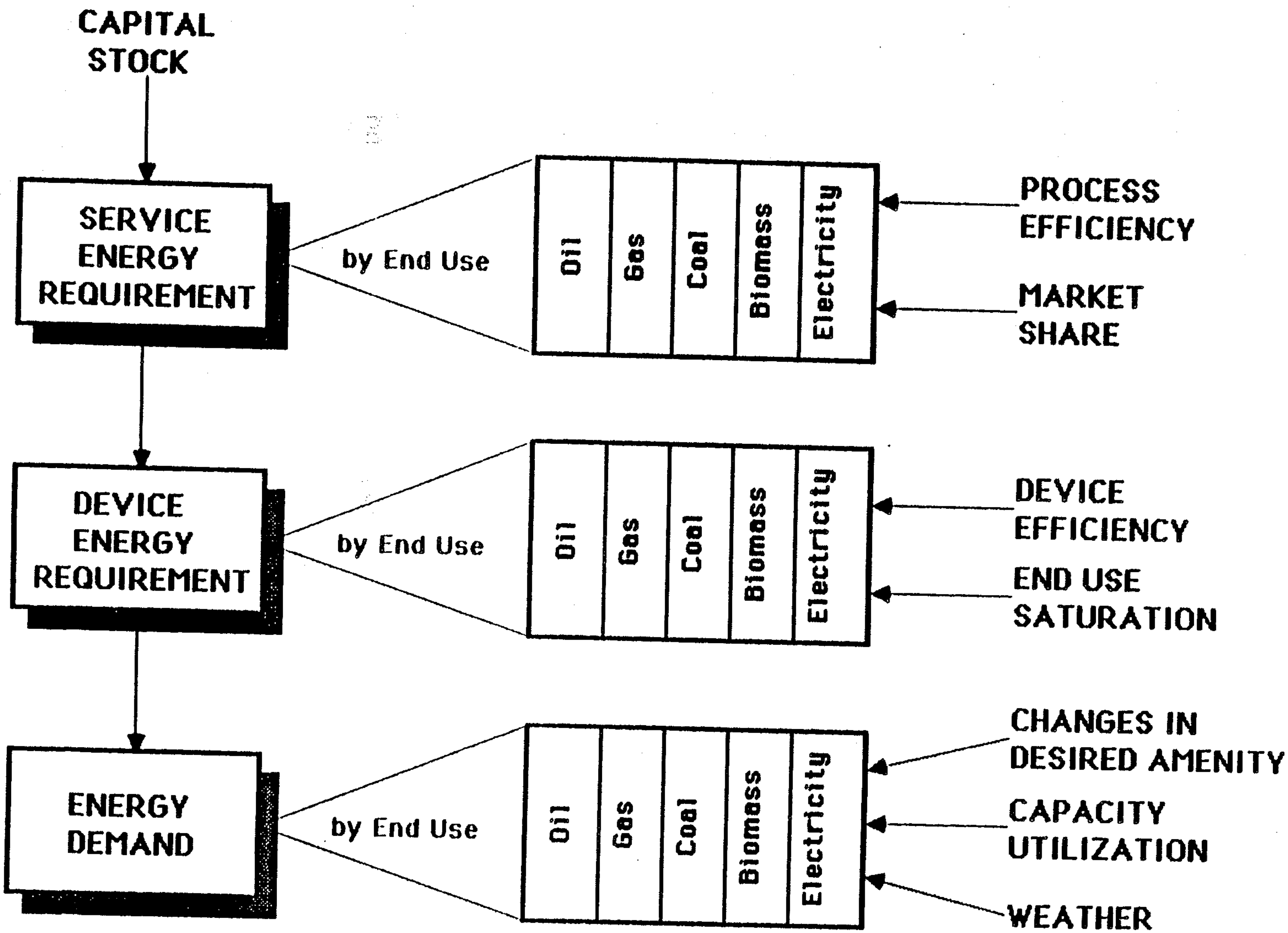

Figure 4. Overview of the ENERGY 2020 Demand Model

Lessons We Have Learned So Far

After listening to vocal champions of both approaches, we are trying a mixed strategy. Our preliminary conclusions can be summarized as follows:

1. You must be able to deliver the organizational learning environment on the hardware that is in place already. If you have to argue for a new hardware platform, you will use up too much good will before you can even start your teaching.

2. Codifying teaching expertise into a successfully working stand-alone learning environment has not as yet been completed. The effort involved is at least as great as that required to develop the functional model itself.

3. Today's hardware platform may be tomorrow's PCjr: do not tie your organizational learning environment too close to any one technology. Do not limit your conceptualization to today's software and hardware options.

4. Frame the issue as a teaching issue and not a technology issue. Focus should be placed on how problem solving skills can be taught rather than what can be accomplished in a particular medium.

5. You must get the learners themselves to generate the insights you want them to learn. Developing management games may be the best approach for sustaining interest for a number of reasons:

    5.1 Games do not run unless the players make the decisions necessary to move the game forward. Hence, the outcome is felt to be their outcome.

    5.2 The learner's input must be significant. We should not let the learner get the feeling that the game's internal logic always generates the wanted result regardless of user input.

    5.3 As players become more sophisticated, so must the game. At a certain point, we must introduce the real model, in our case ENERGY 2020, as more than a repository of information which players can consult to play better games.

    5.4 Games produce real winners and users learn by trying to win. This harnesses people's competitive nature to achieve a desired end and allows real emotion to enter the exercise.

We are continuing our efforts and welcome criticism and suggestions.

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