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Anticipating the Effect of Shortages

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Shortages of any vital raw material—oil, bauxite, coal—can have catastrophic effects on manufacturer, supplier, and customer. Here two specialists present a method of evaluating such impact they advised their clients to adapt during the recent energy crisis—

ANTICIPATING THE EFFECT OF SHORTAGES

by R. Bruce MacGregor
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Ernst & Ernst

AMERICANS today are bathing in a wave of euphoria. The Arabs have lifted the oil embargo, God's in his heaven, and all's right with the world. Gasoline's available again, cars are on the road, the winter's past, and no one froze.

It's a happy state, but it may well be a short-lived one. The Arab nations, discovering just how potent their oil weapon could be, have lifted the oil embargo for two months. Then it is subject to review. And possibly restoration. The price of Middle Eastern oil has already skyrocketed. The age of low-cost energy has gone. Energy may be abundant but it won't be cheap in the foreseeable future. It may very well be neither cheap nor abundant.

The oil embargo imposed by the Arabs caused great short-term difficulties, of course. Most of these have now been eased. But the overall dimensions of the energy crisis have not. We are still short of energy, not as short as we were in the middle of winter, but still short of our requirements. So a sudden abundance of energy would be a danger sign for the economy, a sure signal that we were heading into a severe recession. To that degree a slight shortage of necessary energy is a hopeful sign for the economy as a whole. But it's also a danger sign to the individual business.

This has meaning to every businessman, of course, but its significance extends well beyond the energy requirements of his own business. We have already seen this in the very short-term truckers' strike that occurred at the beginning of February, when the combination of high diesel fuel costs and an arbitrary speed limit goaded many truckers to stop work. Meat packing plants do not depend heavily on energy, yet the effects of the truck strike forced them to close throughout the Midwest.

A business's suppliers' and customers' problems can have a very direct effect on its business.

What every business needs is an approach, a method of isolating the

good and bad news the high cost of energy (and the possible reimposition of the Arabs' oil embargo) is apt to bring it, and a plan to cope with the possible consequences. This must be based on an understanding of possible changes in its supply and demand relationships caused by the oil shortage, whether that shortage is absolute, as it was during the worst days of the crisis, or relative, as it is now in terms of foreign oil cost.

For example, toy manufacturers do not use a disproportionate amount of energy in their own manufacturing processes. But they depend heavily on plastics for use in their products. Their suppliers are going to be heavily handicapped since plastics are made from petrochemicals. The same thing is true of every other manufacturer who uses plastics. And of every clothing manufacturer who employs synthetic fabrics in his products.

These are contingencies that can be met. There are wood and metal to replace plastics. There are wool and cotton and rayon to replace synthetic fabrics based on petroleum derivatives. But they can be met only if the ultimate producer can anticipate exactly how the petroleum shortage is apt to affect him and his product, and if he has time to investigate alternative sources of supply.

Customers are apt to be as seriously affected as suppliers. If the manufacturer builds small cars, he can reasonably expect orders to go up, even though gasoline supplies have become much more abundant since the most acute days of the energy crisis. The higher prices at the fuel pumps will ensure small car demand. If he is engaged in public transportation, he can reasonably expect to see his business increase for the same reason and because of the tentative nature of the latest Arabian move. His suppliers, bus manufacturers, builders of railway cars and equipment, can anticipate their volume will go up as well.

What are some of the organizations that can anticipate increased demand for their services, and thus can reasonably be expected to need a greater flow of supplies?

Ski and vacation resorts close to a major city (within easy driving distance and comparative safety from gas shortages) should prosper. The memory of endless gas queues is still fresh, and there is always that continuing rise in fuel prices.

Products where demand drops

Products where demand could be expected to drop would be: luxury items, such as pleasure boats, vacation homes in the country, snowmobiles, very large cars. All of these could be supported in our present fuel situation, but they are each expensive in themselves. How many people would want to invest in them while the Arabs are "playing yo-yo" with their embargo weapon is problematical. The next review of the Arabian stance on oil exports is due in June.

There is another problem: that of the manufacturer buying products that are in themselves marginal to the suppliers. Such suppliers may be more than willing to sacrifice such products if fuel becomes either too scarce or too expensive.

So there are three main aspects of the fuel shortage that must be taken into account when a business tries to plan for its future in these uncertain times: the effect it will see directly in its own operations, the effect on its suppliers, and the effect on its customers.

Plan suggested

We suggest to our clients that they set up an energy-cost impact review in the form of a matrix to provide the necessary evaluation structure. This would be somewhat as shown in Exhibit 1, page 23. Use of the matrix defines the nine studies that can be integrated into a company-wide energy review.

What are the elements of these studies that are common to businesses and to all clients?

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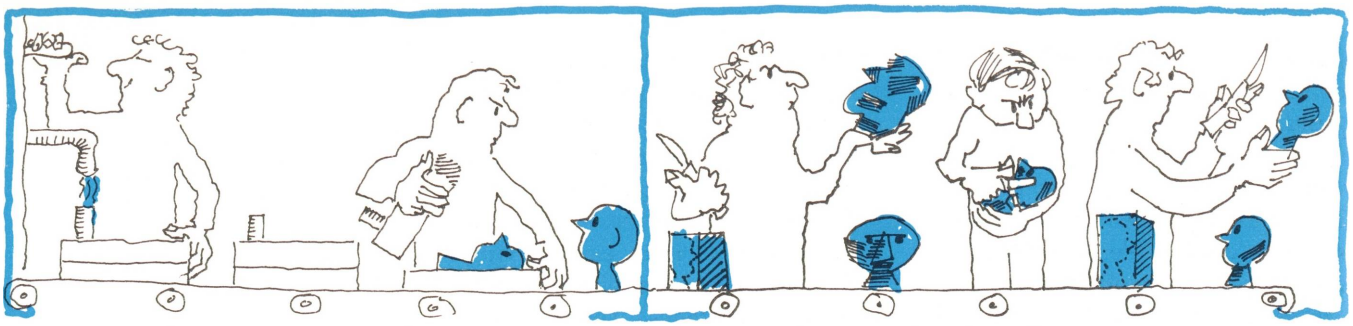

Toy manufacturers do not depend heavily on energy. But they do use a great quantity of plastics in their products. They can at least use wood and metal to replace the plastics made from oil.

There are four basic tasks involved:

- Identifying the historical facts (or the current ones) that are needed,
- Determining where the information may be obtained,
- Designing a structure for classifying information,
- Collecting the facts.

The data audit is specifically designed to answer questions about an unknown and unknowable future. It is designed to display the facts on activities and items that, properly analyzed, may reveal the characteristics of the impacts. It is an aid to finding the best possible solution to all problems that might arise, rather than an attempt to predict what those problems might be. It is, in effect, a plan for all contingencies that might occur in the future.

Supplier audit—The aim of the first task is to identify the basic data needed to support a supply requirements analysis which will highlight those supplies that are vital to maintaining the business, and those that are subject to restriction or curtailment. For a manufacturing company, for example, the data needed might include volume and type of steel, fasteners, motors, paint and finishes, plastics, computer services, delivery services, etc. Inspection of invoices paid will provide a ready source of all outside suppliers and supplies, while inspection of the bill of materials, plant production schedule, and company information system will provide an insight into the critical nature of the supplies. Vulnerability of supplies when not known, may be assessed by using outside information sources.

Vulnerability to shortages

The emphasis in the second task is on finding information about the vulnerability of suppliers to shortage curtailment of production. Examples of sources of information are:

- Economic and production data from trade journals, Government publications, newspapers, etc.
- Personal communication with suppliers of key items
- Use of economic input/output models (from which some sample data are presented later)
- Supplier trade association information
- Perusal of the Federal regulations governing the availability and cost of petroleum products to supplier industries.

Task Three, establishing a set of classes within which to collect data, is essential for sorting out what information about supplies is useful for assessing how vulnerable the company may be to loss or shortage of supply (due to supplier rationing, or supplier loss of petroleum products). While specific classes will vary considerably among companies, certain dimensions would seem to be universally important:

- Input material (raw, semi-finished, and finished in the case of, for example, wholesale/retail) classed by number of processing steps (e.g., mined and delivered; mined, purified, shaped, and delivered; etc.).
- Supplier characteristics such as distance from company, U. S. or foreign (and specific country for foreign), approximate number of other suppliers of the same product/service, degree to which prevailing regulations assure petroleum products to the suppliers.

Assembling the data

The last task, actually assembling the data, requires a decision on what specific information to collect, e.g., volumes, cost, uses, consumption/use patterns (seasonality), etc. It is important for the manager to continually characterize supplies in terms pertinent to energy impacts. This focus will facilitate elimination from consideration of those supplies which have an assured availability, are not critical, or are generally unaffected by energy shortages or sharply increased costs.

Operations audit—The purpose of this audit is to develop a meaningful representation of the sources and applications of energy in business operations. Identification of the information needed and its source (Tasks One and Two) are simple matters. Energy would include electricity, natural gas, propane, fuel oil, coal, and middle distillates. The details of the classification, Task Three, would be determined by the characteristics of the company. For some companies, for example, a breakdown of fuel oil by grades may be useful. The structure of sources and applications should be constructed so that a clear picture

of energy usage is developed in sufficient detail to allow analysis of the impacts of supply shortages of different severity. A general illustrative example, again using a manufacturing company, is shown in Exhibit 2, at the right.

Exhibit 2 suggests that the important dimensions are a broad classification of uses (e.g., non-process, process, and transportation), including locational units (e.g., offices, plants, and centers within these as appropriate), and elements descriptive of energy use (e.g., heat, light, machine tools, electric furnaces). The level of detail in the structure should be guided by:

- Quantity of energy consumption
- Importance to operations
- Likelihood of renewed energy shortage or escalating costs.

Having defined a structure, the last task has two steps. The first step is to describe energy consumption by source, such as quantity, time patterns (seasonality or other factors influencing use rates), special characteristics (e.g., contractual arrangements concerning peak loads and costs), and other important characteristics (e.g., storage capacity for fuel oil used as a back-up to the interruptible natural gas service).

EXHIBIT 1

Suppliers:	Data Audit	Impact Analysis	Plan Formulations
Company Operations:	Data Audit	Impact Analysis	Plan Formulations
Customers/Market:	Data Audit	Impact Analysis	Plan Formulations

EXHIBIT 2

Illustrative Operations Audit Energy Source and Application Matrix

	Cost of Fuel* Oil (#6)	Cost of Natural Gas	Cost of Elec-tricity	Cost of Gasoline*	Cost of Middle Distillates
Non-Process					
Administrative Office					
Heat					
Light					
Equipment (non-process)					
Plant A					
Heat					
Light					
Equipment (non-process)					
Process					
Plant A					
Shipping & Receiving					
Fork Lifts					
Other Equipment					
Machine Shop					
Machine Tools					
Heat Treating					
Electric Furnaces					
Gas Furnaces					
Plant B					
Shipping & Receiving					
Transportation					
Tractor-Trailer Fleet					
Small Vehicles Fleet					

* For these products, a separate array could be developed to show the alternative sources available to the company.

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The next step is to allocate the energy consumption down through the applications structure. It may be advantageous to assign the energy to systems prior to a detailed allocation. For example, the company may have three separate heating systems using fuel oil. Allocating first to a heating system and then to facilities or zones within facilities may contribute to subsequent analysis.

An alternative second step may be useful to consider for some businesses—development of process flow of product components by production centers and allocation of each center's energy use to the components. Because this type of analysis could be very complex and time consuming, it would be appropriate to consider only if a business anticipates significant energy shortages or critically heightened costs (perhaps complicated by supply disruptions) to a degree that the company must select which products will be curtailed. Significant growth opportunities within constrained supplies may also justify this detailed data development.

Customer audit – As noted, the energy crisis will alter traditional supply/demand relationships. Thus, the first task here is to identify the possibilities for increased or decreased demand for a company's products or services. Among these are:

- A decrease in customer demand due to a shift in consumer

EXHIBIT 3

Classification of Customer Data

a. Manufacturing Company

Customers	Products			
	Drills	Saws	Planers	Sanders
Construction Company				
Hardware Stores				
Department Stores				
Direct Sales				

b. Distribution Company

Customers	Products		
	Warehousing	Over Road Transportation	Local Distribution
Manufacturing Company			
Wholesalers			
Retailers			

buying patterns (e.g., for tourism or travel-oriented products or services) or possibly an increase in demand (e.g., in-home recreation products).

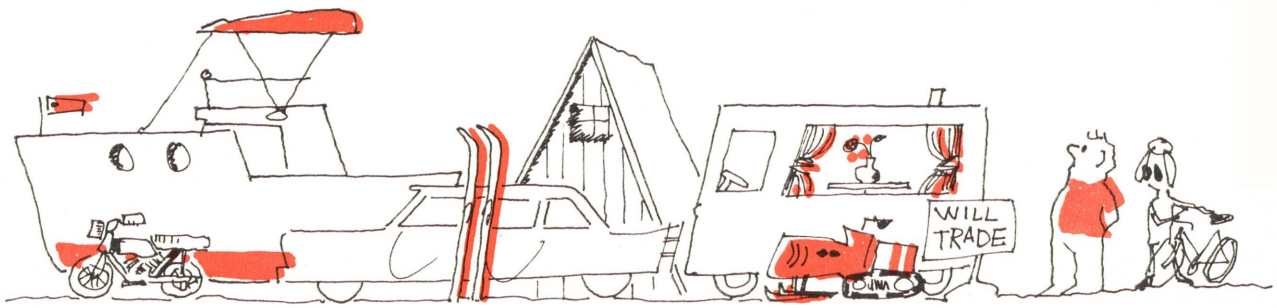
- A decrease in customer demand caused by supply shortages or cost increases the customer is experiencing from other sources.
- A decreased output of the company, making rationing among customers necessary.
- Substitution by customers of some other material or product not provided by the company due to, for example, energy-crisis-caused price changes, risk potential of future supply shortages or cost increases, need for customers to conserve processing energy, or other reasons. These same factors could increase demand if the company is the one to which customers are switching.

These examples suggest that a company is vulnerable to, or has opportunities arising from, a variety of possible changes in expected demand based on patterns. Thus, the task of designing a useful matrix for classifying customer data must carefully consider sectors of potential impact. This task is made more difficult by the fact that the demand changes may begin several processing steps beyond the company's product or services, such as by a customer's customers. The basics of the matrix would be a classification of customers in one dimension, and products or services sold to them in the other (see Exhibit 3, at the left). The characterization of customers might include name, their use of the company's product, and information about their customers, if appropriate. The customers might be classified together in logical groupings, e.g., export and domestic consumer product, capital equipment, intermediate producer, etc. The Standard Industrial Classification (SIC) codes might be useful for this purpose.

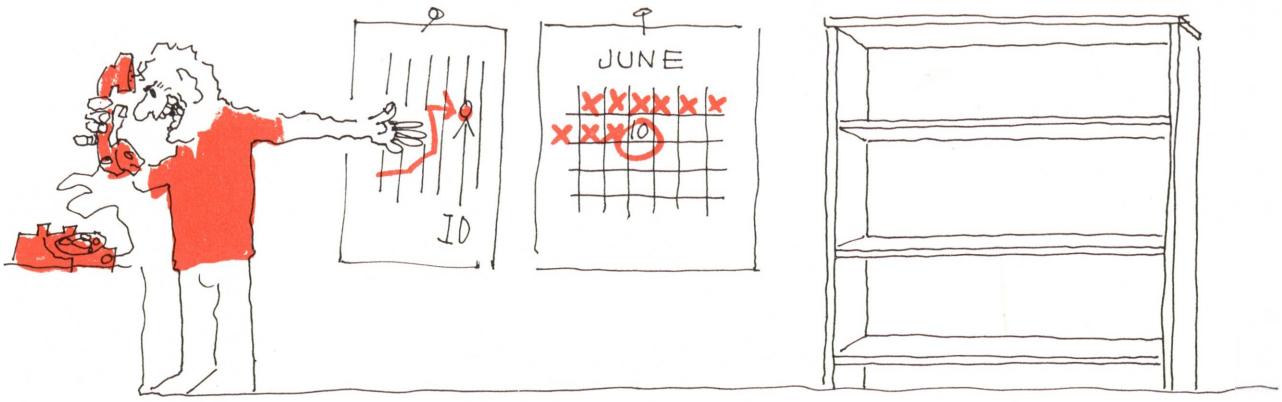
Collecting the information

The fourth task, collecting pertinent information for the customer data base, should then be completed, including quantity, price, seasonality, contractual commitments, and similar data that quantify and describe the business relationships. The assistance of outside sources such as wholesalers, manufacturers representatives and agents, and possibly an input/output analysis may be necessary to properly do this task.

Supplier analysis—The major steps of the supplier analysis are to identify energy- or energy-cost-related shortages; assess their severity; identify the possible range of price changes associated with short-



Products where demand could be expected to drop would be items such as pleasure boats, vacation homes in the country, very large cars. They could be supported in our current state of fuel availability but they're expensive in themselves and a renewed oil crisis would make them prohibitive.



The wise company will review its entire MIS in view of potential shortages. In a time of shortages, the time to re-stock inventory may be whenever the needed goods are available, not according to inventory level re-order points.

ages (e.g., while a product may be in short supply, a company can still get as much as is needed at, say, three times the former price); evaluate possible solutions; and quantify the implications of uncorrectable supply shortages that might occur. The analysis will employ the following approaches: judgmental estimates based on characteristics of supplies and suppliers, evaluations of alternative materials and source of supplies, a "simulation" of the production process, and a "model" of the interrelationships among the company and its suppliers. Clearly, the depth of analysis and degree of sophistication will vary depending on the company. In some instances, companies will already have a solid information base about supplies (e.g., an oil dealer whose main supplier is an oil wholesaler). In other instances, the knowledge will have to be refined (e.g., the manufacturer who requires aluminum motor housings, wire, insulation, etc.).

Next, the manager must examine the vulnerability of the company to severe levels of energy supply reduction caused by price increases or resumption of the embargo. The operations audit will have described historical and expected energy use disregarding the energy crisis. The conservation analysis will define attainable reductions without curtailing output and, hence, will indicate the extent of company flexibility. Foreseen use with conservation actions implemented establishes an upper limit of energy use for maintaining planned activities. The next task is to establish a lower boundary which is the irreducible minimum energy level needed to *stay* in business. For example, safety, health, and efficiency considerations may show that plants and offices need to be heated no lower than 60° during working hours and 46° during non-working hours; elements of a processing system often will require a significant minimum energy use. The basic minimum requirement will not likely be a single set of figures but rather alternatives based on alternative operations assumptions. For example, assumptions on working hours establish the time for which maintaining 60° is necessary.

Between the minimum-to-stay-in-business usage and usage with conservation actions implemented is a range of energy consumption which, if curtailed, would reduce production or services provided. One way to examine vulnerability in this area is to make reasonable assumptions about potential energy shortage or cost increases and then to identify the most favorable way to curtail activities; that is, to minimize the impact of the new energy levels required. The result of this analysis would establish alternative actions for energy shortages below the conservation level and above the fixed minimums.

Customer analysis—The customer analysis must use the audit data to address two basic situations:

- Allocating products/services among customers if the company is limited by supply shortages to output less than demand, if it is forced to ration its products in other words.
- Identifying how pre-existing customer demand may have changed and hence changed total demand for the company's products.

The company basically faces the same allocation options and decisions as a government in wartime: rely exclusively on price; provide reduced allocations with extra amounts available at penalty prices; or rely on strict rationing. The selection of the appropriate method will probably be influenced by such factors as the degree of competition for consumers; stability of business relationships; length and severity of shortage; type and volume of products; and manpower available to implement allocation. The pricing options do, of course, have important limitations, such as price controls, and antitrust regulations.

Identification of how pre-existing customer demand may change is the mirror image of identifying how supplier availability may change. The steps to be taken are exactly the same. Table 1 (on page 26) shows the resulting demand changes for several sample industries as estimated by an economic input/output model. Table 2 on page 26 shows the detail underlying the totals for the household furni-

ture industry. Note that the tables can also be read from the customer's viewpoint to reveal supplier changes. This information comes from the Interindustry Forecasting Model (INFORUM) at the University of Maryland, for which Ernst & Ernst is one of the sponsors.

Action and contingency plans

Very possibly in performing an impact analysis, a company will find other matters which must be reflected in its action/contingency plans. For example, the foreseen demand changes may be so significant that work-in-process, finished goods, and accounts receivable valuation would need review; and the value of certain capitalized R&D may decline. A company finding indicators of curtailment, even if in growth rather than absolute, may determine that cost reduction programs are needed to protect profit margins. A similar program might be triggered by supply price increases. Also impacted might be growth plans (e.g., those to increase capacity), cash flow, and new products or services in developmental stages. Certainly, the managers will be alert to the overall implications to their business while performing the basic impact analysis.

The last task, then, is the development of the specific steps to be taken now (the action plan) and the possible steps to be taken if specified events occur in the future (contingency plan). A normal procedure would be to establish an action plan for immediate implementation (e.g., to reduce cost, to preserve output levels, to achieve a more protected level of operations, etc.) and formulate a series of contingency plans with specific trigger mechanisms (e.g., two consecutive months where fuel deliveries are 10 per cent below requirements; input lead times for item A going over six weeks; allocations of supplies falling to 90 per cent of requirements, etc.).

A crucial element for the success of this whole exercise is to estab-

TABLE 1

Illustration of How Industry Demand Changed with Recent Energy Crisis

Industry	Growth Rate in Per Cent for the Period Shown		
	1973-74	1973-75	1975-78
Buses and Local Transit			
Pre-Crisis		1.84	1.38
Crisis	17.35	12.09	3.51
Coal Mining			
Pre-Crisis		.80	1.79
Crisis	13.94	9.62	3.19
Household Furniture			
Pre-Crisis		2.60	2.33
Crisis	—1.68	2.41	2.47
Wall and Building Paper			
Pre-Crisis		—1.76	1.93
Crisis	—7.40	—2.36	2.06
Paperboard Containers			
Pre-Crisis		3.40	3.08
Crisis	1.48	2.93	2.91
Retail Trade			
Pre-Crisis		3.73	3.31
Crisis	1.65	3.02	3.37
Banks			
Pre-Crisis		5.83	4.71
Crisis	4.97	5.69	4.80
Hotel and Lodging Places			
Pre-Crisis		5.12	4.15
Crisis	4.48	5.02	4.24

* "Energy Crisis" reflects the estimated reduction in oil available from the Middle East.

TABLE 2

Interindustry Flows for Household Furniture Pre-Crisis Forecast

Purchasers from Household Furniture Industry	Growth Rate in Per Cent for the Period Shown				
	1971-85	1973-75	1975-80	1980-85	1973-85
Household Furniture	3.0	2.6	2.4	1.5	2.1
Radio and TV Receiving	5.6	5.1	3.8	2.8	3.6
Trailer Coaches	2.5	2.2	2.6	3.3	2.8
Sum of Intermediate Flows	4.2	4.0	3.2	2.6	3.1
Wholesale & Retail Trade	3.6	3.5	3.0	1.9	2.6
Communication	4.8	—.8	3.4	2.2	2.2
Finance and Services	3.2	2.7	.8	—.1	.7
Electric Utilities	3.9	.2	3.3	2.2	2.3
Sum of Sales to Capital Equipment Buyers	3.8	2.0	2.3	1.3	1.8
Residential Construction	.9	—11.4	1.9	1.2	—.6
Additions and Alterations	1.3	1.4	1.2	1.0	1.2
Sum of Sales to Construction Activities	1.0	—8.4	1.7	1.1	—.2
Personal Consumption	3.2	3.9	2.8	2.2	2.7
Change in Inventories	—.1	—15.5	—5.2	—7.5	—7.9
Imports	7.3	—1.6	7.1	9.5	6.6
Sum of Sales to Final Demand	2.9	3.7	2.4	1.4	2.2
Total	3.0	2.6	2.4	1.5	2.1

lish a way to measure the effect of the contingency plan, and a way to follow events which are the basis of the contingency plans. While this appears to be a self-evident statement, too often plans have been implemented without appropriate monitoring and control so that, if not disastrous, the results were less than desired. The monitoring and control element is particularly important in the contingency plans area, where false signals might set a plan in motion when it was not needed, or a real signal might be missed and a needed response was not implemented.

Summary

This article has attempted to show some of the ways in which the energy-crisis/energy-cost shortage, with its resultant change in supply-demand relationships, could impact businesses of all types. The crucial task for a business is to effectively evaluate the effects on its operations and profits. Fortunately, there are techniques and tools available to systematically analyze the energy impacts. The matrix discussed herein provides an orderly approach for developing data audits, impact analyses, and alternative plans for dealing with suppliers, company operations, and customers/markets. These, in turn, produce a complete energy impact evaluation whereby a business can better cope with the likely changes.

Everything we are recommending about fuel shortages applies equally well to a number of other raw materials imported from abroad that may be in artificially induced short supply in the immediate future. The Arabs in their maneuvers with the oil weapon inspired many other producers of materials, that the industrialized nations don't have, to think long second thoughts about how they might use their resource as a bargaining medium. Bauxite producers have already tried it—although not too successfully. The next producers' cartel will learn from their mistake. We may well be in for a series of economic shortages throughout the foreseeable future.

And, depending on the raw material that's in short supply, the crisis to the manufacturing company may be even more unexpected than were the effects of the fuel crisis. Many multiplant companies have routine operations, such as setting inventory level stock points at a prefigured level, that are all controlled from plant headquarters. But in a time of shortage, the time to re-stock inventory may be whenever the needed goods are available. The wise company will review its entire MIS system in view of these changing factors.

All protective measures outlined in this article can be used to meet these situations exactly as they could for oil.

All of the suggestions made in this article may seem entirely too elaborate for a crisis that seems to be past. But its price consequences aren't. Nor its duration. The oil-producing states are due to re-evaluate on June 1 their action in lifting the embargo late in March. If they should reimpose the embargo, after a two-month period without it, the consequences could be even more severe than they were the first time. The company that has made future contingency plans based on this possibility cannot help being better equipped to deal with whatever happens than the firm that has happily assumed the worst was over in March.

Furthermore, the Government has belatedly been giving warnings that the lifting of the Arab embargo doesn't solve all the United States' energy problems by a long shot. It alleviates them, yes. But the country is falling behind consistently in matching energy supplies with energy consumption. Sooner or later we're going to be seriously short of energy again even if all the oil-producing states do their very best to increase pre-crisis allotments. And there again, the company that has a well thought-out plan as to what to do will have the advantage.

. . . too often plans have been implemented without appropriate monitoring and control so that, if not disastrous, the results were less than desired. The monitoring and control element is particularly important in the contingency area, where false signals may set a plan in motion when it's not needed . . .