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The Parable of the Spindle

Elias H. Porter

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More and more we hear the word "systems" used in discussions of business problems. Research people are studying systems, experts are looking at organizations as systems, and a growing number of departments and companies have the word "systems" in their names.

Just what is a system in the business sense? What does it do? What good is it to management? To answer these questions I shall first use a parable from the restaurant industry. What, you may ask, can executives in manufacturing, retailing, or service systems learn from restaurant systems? I readily admit that if you envisage only menus, customers, waitresses, and cooks in a restaurant, you will find no transferable knowledge. But if you see (as I hope you will) inputs, rate variations, displays, feedback loops, memory devices, queuing, omissions, errors, chunking, approximating, channeling, and filtering in a restaurant system—then you should indeed find some practical value in my parable.

The implications of the parable will be discussed specifically in the second part of the article, after we have reduced it to a paradigm.

THE PARABLE

Once upon a time the president of a large chain of short-order restaurants attended a lecture on "Human Relations in Business and Industry." He attended the lecture in the hope he would learn something useful. His years of experience had led him to believe that if human relations problems ever plagued any business, then they certainly plagued the restaurant business.

The speaker discussed the many pressures which create human relations

Author's note: I am indebted to William Foote Whyte of Cornell University for having developed the spindle in real life.

problems. He spoke of psychological pressures, sociological pressures, conflicts in values, conflicts in power structure, and so on. The president did not understand all that was said, but he did go home with one idea. If there were so many different sources of pressure, maybe it was expecting too much of his managers to think they would see them all, let alone cope with them all. The thought occurred to him that maybe he should bring in a team of consultants from several different academic disciplines and have each contribute his part to the solution of the human relations problems.

And so it came to pass that the president of the restaurant chain and his top-management staff met one morning with a sociologist, a psychologist, and an anthropologist. The president outlined the problem to the men of science and spoke of his hope that they might come up with an interdisciplinary answer to the human relations problems. The personnel manager presented exit-interview findings which he interpreted as indicating that most people quit their restaurant jobs because of too much sense of pressure caused by the inefficiencies and ill tempers of co-workers.

This was the mission which the scientists were assigned: find out why the waitresses break down in tears; find out why the cooks walk off the job; find out why the managers get so upset that they summarily fire employees on the spot. Find out the cause of the problems, and find out what to do about them.

Later, in one of the plush conference rooms, the scientists sat down to plan their attack. It soon became clear that they might just as well be three blind men, and the problem might just as well be the proverbial elephant. Their training and experience had taught them to look at events in different ways. And so they decided that inasmuch as they couldn't speak each others' languages, they might as well pursue their tasks separately. Each went to a different city and began his observations in his own way.

The Sociologist

First to return was the sociologist. In his report to top management he said:

> I think I have discovered something that is pretty fundamental. In one sense it is so obvious that it has probably been completely overlooked before. It is during the *rush hours* that your human relations problems arise. That is when the waitresses break out in tears. That is when the cooks grow temperamental and walk off the job. That is when your managers lose their tempers and dismiss employees summarily.

After elaborating on this theme and showing several charts with sloping lines and bar graphs to back up his assertions, he came to his diagnosis of the

situation. "In brief, gentlemen," he stated, "you have a sociological problem on your hands." He walked to the blackboard and began to write. As he wrote, he spoke:

> You have a stress pattern during the rush hours. There is stress between the customer and the waitress. . . .
>
> There is stress between the waitress and the cook. . . .
>
> And up here is the manager. There is stress between the waitress and the manager. . . .
>
> And between the manager and the cook. . . .
>
> And the manager is buffeted by complaints from the customer.
>
> We can see one thing which, sociologically speaking, doesn't seem right. The manager has the highest status in the restaurant. The cook has the next highest status. The waitresses, however, are always "local hire" and have the lowest status. Of course, they have higher status than bus boys and dish washers but certainly lower status than the cook, and yet they give orders to the cook.
>
> It doesn't seem right for a lower status person to give orders to a higher status person. We've got to find a way to break up the face-to-face relationship between the waitresses and the cook. We've got to fix it so that they don't have to talk with one another. Now my idea is to put a "spindle" on the order counter. The "spindle," as I choose to call it, is a wheel on a shaft. The wheel has clips on it so the girls can simply put their orders on the wheel rather than calling out orders to the cook.

When the sociologist left the meeting, the president and his staff talked of what had been said. It made some sense. However, they decided to wait to hear from the other scientists before taking any action.

The Psychologist

Next to return from his studies was the psychologist. He reported to top management:

> I think I have discovered something that is pretty fundamental. In one sense it is so obvious that it has probably been completely overlooked before. It is during the *rush hours* that your human relations problems arise. That is when the waitresses break out in tears. That is when the cooks grow temperamental and walk off the job. That is when your managers lose their tempers and dismiss employees summarily.

Then the psychologist sketched on the blackboard the identical pattern of stress between customer, waitress, cook, and management. But his interpretation was somewhat different:

> Psychologically speaking, he said, we can see that the manager is the father figure, the cook is the son, and the waitress is the daughter. Now we know that in our culture you can't have daughters giving orders to the sons. It louses up their ego structure.
>
> What we've got to do is to find a way to break up the face-to-face relationship between them. Now one idea I've thought up is to put what I call a "spindle" on the order counter. It's kind of a wheel on a shaft with little clips on it so that the waitresses can put their orders on it rather than calling out orders to the cook.

What the psychologist said made sense, too, in a way. Some of the staff favored the status-conflict interpretation while others thought the sex-conflict interpretation to be the right one; the president kept his own counsel.

The Anthropologist

The next scientist to report was the anthropologist. He reported to top management:

> I think I have discovered something that is pretty fundamental. In one sense it is so obvious that is has probably been completely overlooked before. It is during the *rush hours* that your human relations problems arise. That is when the waitresses break out in tears. That is when the cooks grow temperamental and walk off the job. That is when your managers lose their tempers and dismiss employees summarily.

After elaborating for a few moments he came to his diagnosis of the situation. "In brief, gentlemen," he stated, "you have an anthropological problem on your hands." He walked to the blackboard and began to sketch. Once again there appeared the stress pattern between customer, waitress, cook, and management:

> We anthropologists know that man behaves according to his value systems. Now, the manager holds as a central value the continued growth and development of the restaurant organization. The cooks tend to share this central value system, for as the organization prospers, so do they. But the waitresses are a different story. The

only reason most of them are working is to help supplement the family income. They couldn't care less whether the organization thrives or not as long as it's a decent place to work. Now, you can't have a noncentral value system giving orders to a central value system.

What we've got to do is to find some way of breaking up the face-to-face contact between the waitresses and the cook. One way that has occurred to me is to place on the order counter an adaptation of the old-fashioned spindle. By having a wheel at the top of the shaft and putting clips every few inches apart, the waitresses can put their orders on the wheel and not have to call out orders to the cook. Here is a model of what I mean.

Triumph of the Spindle

When the anthropologist had left, there was much discussion of which scientist was right. The president finally spoke. "Gentlemen, it's clear that these men don't agree on the reason for conflict, but all have come up with the same basic idea about the spindle. Let's take a chance and try it out."

And it came to pass that the spindle was introduced throughout the chain of restaurants. It did more to reduce the human relations problems in the restaurant industry than any other innovation of which the restaurant people knew. Soon it was copied. Like wild fire the spindle spread from coast to coast and from border to border.

So much for the parable. Let us now proceed to the paradigm.

THE PARADIGM

Each of the three scientists had seen a different problem: status conflict, sex rivalry, and value conflict. Maybe it was none of these but simply a problem in the division of work between men and machines and how they are related one to the other: a problem of system design. Let us explore this possibility by observing the functions which the spindle fulfills.

Functions Served

First of all, the spindle acts as a memory device for the cook. He no longer needs to remember all the orders given him by the waitresses. This makes his job easier and less "stressful"—especially during the rush hours.

Secondly, the spindle acts as a buffering device. It buffers the cook against a sudden, overwhelming load of orders. Ten waitresses can place their orders on the spindle almost simultaneously. The cook takes them off the spindle

according to his work rate—not the input rate. This makes his job easier, more within reach of human capacity—especially during the rush hours.

Thirdly, the spindle acts as a queuing device—in two ways. It holds the orders in a proper waiting line until the cook can get to them. When dependent on his memory only, the cook can get orders mixed up. It also does all the "standing in line" for the waitresses. They need never again stand in line to pass an order to the cook. This makes their jobs easier—especially during the rush hours.

Fourthly, the spindle permits a visual display of all the orders waiting to be filled. The cook can often see that several of the orders call for the same item. He can prepare four hamburgers in about the same time as he can prepare one. By reason of having "random access" to all the orders in the system at that point he is able to organize his work around several orders simultaneously with greater efficiency. This makes his job easier—especially during the rush hours.

To appreciate the fifth function which the spindle serves, we must go back to the procedures used before the advent of the spindle. In looking at these procedures we are going to examine them in "general system behavior theory" terms:

On the menu certain "information" exists in the physical form of printed words. The customer "transforms" this information into the physical form of spoken words. The information is once again transformed by the waitress. Now it exists in the physical form of written notes made by the waitress. Once again the information is transformed as the waitress converts her notes into spoken words directed to the cook. The cook transforms the information from the physical form of spoken words to the physical form of prepared food. We have an "information flow" which looks like this:

Now every so often it happened that an error was made, and the customer didn't get what he ordered. Of course, you and I would have been the first to admit that we had made an error, but not all cooks and waitresses have this admirable character trait. This is rather understandable since the waitress was trying to do things correctly and rapidly (she wanted all the tips she could get!), and when she was suddenly confronted with the fact that an error had been made, her first reaction was that the cook had goofed. The cook, on the other hand, was trying to do his best. He knew in his own heart that he had prepared just what she had told him to prepare. "It's the waitress' fault," was his thought.

So what did the cook and waitress learn? Did they learn to prevent a recurrence of the error? Indeed not! The waitress learned that the cook was a

stupid so-and-so, and the cook learned that the waitress was a scatterbrained so-and-so. This kind of emotionalized learning situation and strainer-of-the-interpersonal-relations any organization can do without—especially during the rush hours.

Changes Effected

Consider now how the spindle changes all this. The waitress prepares the order slip and the cook works directly from it. If the waitress records the order incorrectly, it is obvious to her upon examining the order slip. Similarly, if the cook misreads the slip, an examination of the order slip makes it obvious to him. The fifth function of the spindle, then, is to provide "feedback" to both waitress and cook regarding errors. The spindle markedly alters the emotional relationship and redirects the learning process.

As errors are examined under conditions of feedback, new responses are engendered. The cook and waitress may find the present order slip to be hard to read, and they may request the manager to try out a different style of order slip. Now they are working together to solve the system's problems rather than working against each other and disregarding the system's problems. Maybe they find that abbreviations cause some random errors. For example, it might be that HB (Hamburger) and BB (Beefburger) get mixed up just a little too often, so the cook and waitress get together with the manager and change the name of Beefburger to Caravan Special on the menu because the new symbol (CS) will transmit itself through the system with much less ambiguity—especially during the rush hours.

HANDLING OVERLOAD

Had I been asked a few years ago to advise on human relations problems in the restaurant industry as a professional psychologist, my approach would have been limited to what I now call a "component" approach. My thinking would have been directed at the components in the system—in this case, the people involved. I would have explored such answers as incentive schemes, human relations training, selection procedures, and possibly some time-and-motion studies. My efforts would have been limited to attempts to *change the components to fit in with the system as designed no matter how poor the design might be.*

But now I would first concern myself with the "information" which must be "processed" by the system. My concern would be centered on the functions which would have to be performed by the system and how they might best be performed. I would concern myself especially with how the system is designed to handle conditions of information overload.

It is significant that in our parable the three scientists each discovered that

the human relations problems arose mostly during the rush hours, in the period of "information overload." How a system responds to conditions of overload depends on how the system is designed. Let us look at how various design features permit the handling of conditions of overload in a number of different kinds of system.

Increase in Channels

One of the most common adjustments that a system makes to an excess input load is to increase the number of "channels" for handling the information. Restaurants put more waitresses and cooks on the job to handle rush-hour loads. The Post Office hires extra help before Christmas. The telephone system has recently introduced automatic-switching equipment to handle heavy communication loads; when the load gets to a certain point, additional lines are automatically "cut in" to handle the additional calls. Even our fire departments increase "channels." If there is not enough equipment at the scene, more is called in. Department stores put on additional clerks to handle holiday crowds. Military commanders augment crews in anticipation of overload conditions. Extra communication lines may be called up. More troops are deployed.

Almost everywhere we look we see that systems are very commonly designed to increase or decrease the number of channels according to the load.

Waiting Lines

But there comes a time when just increasing the number of channels is not enough. Then we see another common adjustment process, that of "queuing" or forming a waiting line. There are few readers who have not had the experience of waiting in a restaurant to be seated. Other examples are common. Raw materials are stored awaiting production processes. Orders wait in queue until filled. Manufactured goods are stored on docks awaiting shipment. The stock market ticker tape falls behind.

We have already seen how the spindle makes it unnecessary for the waitresses to queue to give orders. And we are all familiar with the modern custom in most restaurants of having a hostess take our names and the size of our party. What happens when the hostess takes our names down on paper? For one, we do not have to go through the exasperating business of jostling to hold our position in line. Also, the "holding of proper position" is done by machine; that is, it is done by the list rather than by our elbows.

Use of Filtering

The hostess' list also illustrates the way in which a system can make still a third type of adjustment, that of "filtering." Because she jots down the size of the

group, she can now selectively pull groups out of the queue according to the size of the table last vacated. Some readers will recall that many restaurants used to have all tables or booths of the same size and that everyone was seated in turn according to how long he had waited. It used to be infuriating for a party of four to see a single person being seated at a table for four while they continued to wait. The modern notion of accommodations of varying sizes, combined with the means for filtering, makes the use of floor space much more efficient and the waiting less lengthy. We can see filtering in other systems as well:

- The Post Office handles registered mail before it handles other mail, delivers special delivery letters before other letters.
- In the case of our other most important communication system, the telephone system, there is no way for dial equipment to recognize an important call from an unimportant call; it cannot tell whether a doctor is dialing or the baby is playing. However, where long-distance calls must go through operators, there is a chance for filtering. For instance, in trying to place a call to a disaster area the operator may accept only those calls which are of an emergency nature.
- Military systems assign priorities to messages so as to assure differential handling.
- Orders may be sent to production facilities in bunches that make up a full workday rather than in a first-in-first-out pattern. Special orders may be marked for priority attention.

Variations of Omission

A system can be so designed as to permit "omissions," a simple rejection or nonacceptance of an input. The long-distance operator may refuse to accept a call as a means of preventing the lines from becoming overloaded. The dial system gives a busy signal and rejects the call. A manufacturing organization may reject an order it cannot fill within a certain time. A company may discontinue manufacture of one line temporarily in order to catch up on a more profitable line that is back ordered.

As another example of how the design determines what adjustments the system can make, consider the way the short-order restaurant system design utilizes the omission process:

If waiting lines get too long, customers will turn away. That is not good for business, so restaurants often practice another kind of omission. On the menu you may find the words, "No substitutions." Instead of rejecting customers, the restaurants restrict the range of inputs they will accept in the way of orders. Thus time is saved in preparing the food, which in turn cuts down the waiting time in the queue.

The goal of most restaurants is to process as many customers per unit time as is possible. With a fixed profit margin per meal served, the more meals served, the more profit. But when people are in the queue, they are not spending money.

One solution to this is the installation of a bar. This permits the customers to spend while waiting. It is a solution enjoyed by many customers as well as by management.

Chunking and Approximating

Another big timesaver in the restaurant system is the use of a fifth adjustment process, that of "chunking." Big chunks of information can be passed by predetermined arrangements. You may find a menu so printed that it asks you to order by number. The order may be presented to the cook as "4D" (No. 4 Dinner), for example. The cook already knows what makes up the dinner and does not need to be told each item with each order. Preplanning permits chunking, and chunking frees communication channels.

Somewhat akin to the chunking process is a sixth adjustment process, "approximating." To illustrate:

- A business forecaster may not be able to make an exact count of future sales, but he may predict confidently that the sales will be small, moderate, or large.
- An overburdened Post Office crew may do an initial sorting of mail as "local" or "out of town."
- An airborne radar crew may report a "large formation" headed toward the coast.
- An intelligence agency may get a report of "heightened" air activity in a given area.
- An investment house may predict "increased" activity in a certain line of stocks.
- Stock market reports state that industrials are "up" and utilities are "down."

Approximating thus means making a gross discrimination of the input rather than making a fine discrimination.

Trading Errors

A rather unusual adjustment process that a system can adopt to cope with overload is to accept an increase in the number of errors made. It is almost as if systems said to themselves, "It's better to make mistakes than not to deal with the input." For example, the sorting of mail is not checked during rush periods. Mail which is missent must be returned, but in a rush that risk is worth the cost; more mail gets sent where it is supposed to go even though there are more errors. Thus, quality control is given up for the sake of speed. On the other hand, some systems are so designed as to be insensitive to errors. The telephone system will permit you to dial as many wrong numbers are you are capable of dialing.

It is interesting to see in the restaurant system design a deliberate making of errors of one sort in order to prevent the making of errors of another sort during rush hours:

Picture yourself and a couple of friends dropping into a restaurant during the middle of an afternoon. You are the only customers there. The waitress takes your order. You ask for a hamburger with "everything on it." The next person asks for a hamburger but wants only lettuce and a slice of tomato on it. The third person asks for a hamburger but specifies relish and mayonnaise. The work load is low. There is time to individualize orders.

But during rush hours it would be too easy to make errors. Then the cook prepares only the meat and bun. The waitress goes to a table where there are bowls with lettuce leaves and tomato slices and little paper cups of relish and mayonnaise. On each plate she places a lettuce leaf, a tomato slice, a cup of relish, and a cup of mayonnaise. In most instances she will have brought something that the customer did not order, and in this sense she would have made an "error"; but she would have avoided the error of not bringing the customer something he *did* want.

Other examples of the same type are common. For instance, a sales department sends out brochures to everyone who inquires about a product so as not to miss someone who is really interested. Again, the Strategic Air Command, as a central policy, uses this deliberate making of one type of "error" to avoid a possible error of more severe consequences. The commander may order the force launched under "positive control." It is better to have launched in error than to be caught on the ground and destroyed.

CONCLUSION

And so we see that there is a new frame of reference, a new point of view coming into use in approaching the problems of organizations. This new frame of reference looks at organizations as systems which 1) process information, transforming the information from one form into another, and 2) are or are not designed to cope with the conditions of overload that may be imposed on them. This new frame of reference is expressed as an interest in how the structure or design of an organization dynamically influences the operating characteristics and the capacities of the system to handle various conditions of information overload.

At the University of Michigan there are some 50 scientists whose primary interests lie in looking for similarities and differences in system behavior at all levels. They examine single cells, whole organs, individuals, groups, and societies for the manners in which these systems cope with their environments in common and in unique ways. They search the work of other scientists for clues to system behavior at one level that is followed at higher or lower orders of

organization. As for the application of this "system frame of reference," one finds such organizations as System Development Corporation, the RAND Corporation, and the MITRE Corporation using it in approaching the complex problems of advanced military systems. Here is just a sampling of specific developments that bear close watching:

• Because it is possible to view organizations as systems which process data in a continuous sequence of "information transformations" and which may make numerous types of adjustments at the points of transformation, a wholly new concept of training has arisen. In the past, training in business and industry as well as in the military was largely limited to training a man or men to do a given task in a certain way. Now training can be provided that teaches a man or men to adopt adjustment processes suited to the design of the system and the condition of overload. In other words, training for flexibility rather than rigidity is now possible. It should not be long before internal competition is replaced by internal cooperation as the main means of enhancing production.

• Because it is possible to view a business or industry as an information processing system, it is possible to stimulate the information flow on digital computers and, by controlling the adjustment processes at each point where the data are transformed, to learn what effects and costs would be involved in change. The manager will then be able to test his policies realistically on the computer before committing himself in action. A computer program called SIMPAC (Simulation Package) has already been developed at System Development Corporation for this purpose.

• A digital computer program capable of "learning" has been developed. By analyzing how data can be sensed, compared with other data, and stored in the computer's "memory," scientists have been able to "teach" a prototype computer program to recognize letters of the alphabet, cartoon characters, and spoken words. One can look forward to the day when, opening a bank account, he will be asked to sign his name in a variety of situations—e.g., standing, sitting, bending over, and maybe even after a couple of martinis. The computer will learn to recognize his signature from these samples, and at the clearinghouse, after that, his account will be automatically debited and the payee's account automatically credited.

Ludwig von Bertalanffy, the father of general system theory, predicted that general system theory would unify the sciences, thus making it possible for a scientist trained in one area to talk in common terms with another scientist trained in another area.[1] It also seems certain that business and industry will soon profit from the application of the theory of how systems behave.

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[1] "General System Theory," *General Systems* (Ann Arbor, Society for General Systems Research, 1956), Volume I, pp. 1-10.