Systems, Nontrivial Machines, Circular Causality, and Other Ghosts Haunting Performance Improvement Technology

by Klaus D. Wittkuhn, CPT

Applying systemic approaches to any field raises serious questions that are often difficult to answer. Although the questions might appear simple, once asked, they turn out to be tricky. As a performance technologist you might test this for yourself. Think of some "systems" in your work environment and try to answer the following questions so that the answers do not contradict themselves.

- First, when we talk about systems, what systems do we mean? Organizations? Teams? Individuals? Performance systems? Are they all alike or do they have important differences? And what are those differences?
- Systems have boundaries. What are the boundaries of the systems we are talking about in performance technology? What is *inside* the system and what is *outside*?
- Systems have elements. What are the elements *inside* the system, and what are the elements of the system's *environment/outside*?

Taking a systems view is like playing with Russian nesting dolls, which have smaller dolls inside. If you open the first doll, there is another one inside, with an even smaller one inside that, and so on. Systems have subsystems, and what is called "the system" is a distinction made by the observer.

What Are Systems?

Being a system is not a property of some objective entity. It is a mental abstraction made for a special purpose, for example, to improve performance. Answering the questions above becomes important when making sure that the chosen abstraction really serves our purpose.

Systems have emerging properties. This may seem to contradict what I said in the last paragraph—that systems are an intellectual abstraction. In fact it does not. Such an explanation raises fundamental epistemological questions (Von Foerster, 1976; Maturana & Varela, 1980; Spencer-Brown, 1973). The properties are created when the system's elements interact in a specific way. This is where we derive the statement: "A system is more than the sum of its parts." Because emerging properties are caused by interaction we are talking about a "dynamic process producing a time-dependent state" (Gharajedaghi, 1999, p. 44). Performance is just such an emerging property of a system. It is not lasting; it has to be produced continuously in real time.

Most important in a system are the interactions between elements. This leads to more questions: Which elements influence which other elements and by how much? Do these elements have an immediate impact on each other or is there a time delay until impact is observable?

All these questions force performance technology to develop generic yet specific system models to describe human performance. General systems theory teaches us the elements that all systems have: input, output, outcomes, feedback, and environment. But this is not specific enough to describe human performance in general, much less human performance within organizations.

Our technology needs a description of the human performance system that is specific enough to guide analysis, intervention, and evaluation. Figure 1 shows an example of a generic yet specific system model that describes human performance in organizations.

The boundaries of the human performance system are evident in this figure. Input, output, and customer are outside the system. An important loop connects the elements of customer, customer feedback, management, expectations, performer, and output. If the system works properly, the customer feedback element collects information about the customer's needs. Management then translates this knowledge into expectations about the output. Performers perform according to expectations and produce the output the customer requires. Ideally, customer needs, knowledge about those needs, expectations, and output would be exactly alike. In reality this is seldom the case. Therefore, it makes sense to conceptualize all these elements separately so that the model guides the analysis to discover where the gaps between the elements are.

Another element that is needed to make sure that the desired output is produced are a feedback element that continuously compares output against expectations and informs the performer as well as management so they can take corrective action. In addition, a consequences element combines output with appropriate consequences (like rewards), because people act according to the consequences of their actions.

The elements mentioned so far are the *steering* elements of the system. Think of the system as a pipeline. The steering elements ensure that the pipeline delivers the right product at the right time to the right place. Deficiencies in the steering elements damage the system's performance severely.

Next, there are the *enabling* elements. They mirror the double function of management: steering and enabling. Management has to make sure that the performers get the needed resources and that the design of the workplace does not hinder efficient work flow. Performers often need some kind of direct support from their superiors, like coaching. In the pipeline analogy these elements are the diameter of the pipeline. Too little does not allow enough throughput; too much wastes resources.

Then there is *input*. If the input does not meet standards, the performer has to invest additional effort, exerting more

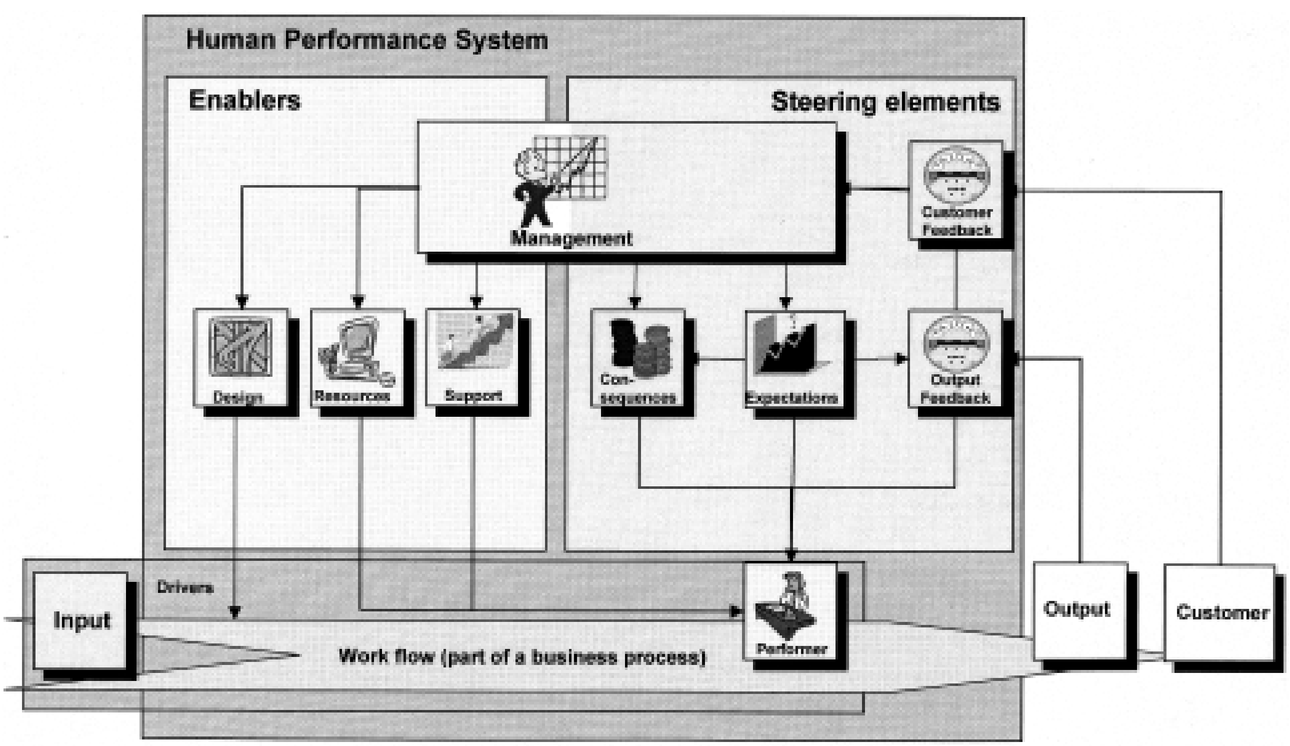

Figure 1. Basic Model of Human Performance in Organizations.

personal capacity, knowledge, and skills. No matter how competent the performer is, if all the other system elements are not operating on an appropriate level, the performer will fall far below his or her capabilities and the output will suffer.

Although the model still leaves many questions unanswered, it allows us to formulate some simple rules concerning human performance systems:

- First, bring the steering elements to an appropriate level, otherwise all improvement is like running faster in the wrong direction.
- Second, bring the enabling elements to an appropriate level. They provide the means to improve throughput.
- Third, work on the drivers and push throughput.

Because the performer is one of the drivers, all measures to improve performance by improving the performer (e.g., training) often come late in the performance improvement process. It is not an intelligent strategy to train people to overcome system deficiencies. Instead, we should design the system properly to make sure that the performers can leverage all their capabilities.

Where in the whole system is performance? Performance is an emerging property of all these elements working together. It can be defined as the system's success in delivering the desired output, at the desired time, at the desired place according to defined standards. Performance cannot be defined as the *capacity* to do so. Performance is the *degree* to which the system uses its capacity.

The model is designed to show consultants and managers what to look for. Thus, it fulfills the requirement of a technology to be able to guide analysis, intervention, and evaluation. The model is *specific* in the sense that it describes human performance in organizations. It is *generic* in the sense that it does not show the individual situation in an individual organization.

This model is not a description of the one-and-only human performance system. It shows one way we might conceptualize such a system and is not yet very detailed. It leaves many questions unanswered, while allowing us to generate a more specific hypothesis.

Engineering Human Performance

I do not think we can engineer human performance. Although "engineering human performance" sounds promising and might attract customers, it is virtually impossible to do.

Let us again consider one of the basic methodological claims of performance improvement: the claim to be systemic. We have seen that performance depends on a number of elements and that those elements are inter-related and influence each other, working together to form a system. An emerging property of this system is its performance. Performance in an organization is always the result of a system—a result of all the elements we've explored here working together in a specific way.

For our purposes, we do not have to identify all the relevant elements that influence performance. We only need to understand that those elements fall into two categories: the human elements of the system—management and the performer—and the nonhuman elements of the system such as expectations, feedback, etc.

One distinction between human and nonhuman elements in a system is that nonhuman elements can be engineered. Engineering is all about control. It makes sure that certain things happen reliably, for example, that machines function reliably unless they are broken. Machines consistently transform input A into output B. At least *trivial* machines do. Trivial machines can be engineered.

In addition to trivial machines, there is a second category called *nontrivial* machines. The difference between a trivial and a nontrivial machine is that when a nontrivial machine receives input A at time T1, that input is not only transformed into output B but also changes the way the machine works. The same input A at time T2 is not transformed into output B but into a different output. It might be C, but we cannot know in advance. Every time an input is transformed like this, the working mechanism of the machine is transformed as well. This is the formal description of learning. Living beings learn.

The consequences are easily illustrated. Imagine that someone kicks a dog. The first time the dog might run away. The second time it might run as well, or it might try to bite its aggressor (which every pet lover would probably like it to do). Or it might run away the moment the aggressor enters the room. We cannot know because the reactions of nontrivial machines cannot be reliably predicted.

We all realize that humans do not behave in a completely arbitrary way. People treat each other politely, they know what to answer when they are asked their name, and they know how to solve mathematical problems. Obviously it is possible to trivialize people. We have designed whole organizations to trivialize people, like schools and universities. But there is always a degree of uncertainty that remains.

To state it differently: Nontrivial machines can be influenced. Sometimes they do what we want them to do, but they cannot be controlled. There is always that uncertainty. Thus, human performance cannot be engineered. The nonhuman elements of the performance system can be engineered, but the human elements can only be influenced. Designing a performance system is an attempt to engineer the nonhuman elements of the system so that their alignment increases the probability that the human elements will behave as desired. It is all about designing a system with an inner logic to which the performers adapt and perform as expected.

But, even in a well-designed performance system, people execute choice, and because people follow their own purposes we can never control what is going to happen.

The Meaning of Cause Analysis in Systemic Technology

Systems thinking creates another problem for performance improvement technology. In systems you rarely find causes. Declaring "cause analysis" to be a major step in the performance improvement process does not mirror systemic thinking at all. It mirrors linear cause-and-effect thinking. Since systems usually show dense interaction between their elements, there will be circular causality that does not allow cause identification. As an example, Figure 2 shows a detail of a human performance system (the whole system is much more elaborate).

In the figure the plusses and minuses denote positive and negative correlation. Positive correlation means that if one element moves in one direction, the other element moves in the same direction. Negative correlation means that a movement in one direction triggers the opposite movement in the correlated element.

We see that the more insufficient the performance, the higher the need to set clear expectations. The greater the need for clear expectations, the higher the probability that clear expectations will be set. The clearer the expectations are, the greater the chances for their likely acceptance and understanding. And the greater the acceptance and understanding of expectations, the better performance will be.

There is an equalizing factor here as well. The clearer the expectations are, the less freedom there is in the system. And if freedom diminishes, motivation diminishes as well. Diminished motivation means diminished performance.

If there is a performance problem, what is the cause? Elements are so inter-related that what seems to be a cause may suddenly turn out to be an effect as well. The meaning of cause as we find it in linear thinking vanishes, with one exception: In linear thinking we would conceptualize performance as the dependent variable and the elements influencing performance as independent variables. Improvements in the independent variables (the causes of performance) would trigger improvement of the dependent variable, performance (the effect). We have seen that this is not true for systems—except that "… a given design may contain some slack between variables. This permits us to deal with each variable separately as though it were an independent variable." We find causes again. This is true until the slack between them is taken up. "Then the perceived set of independent variables changes to a formidable set of interdependent variables. Improvement in one variable would come only at the expense of others" (Gharajedaghi, 1999, p. 14).

Cause analysis is popular because most managers and consultants work with systems that contain slack. Still, theory construction has to take cause analysis as a special case when

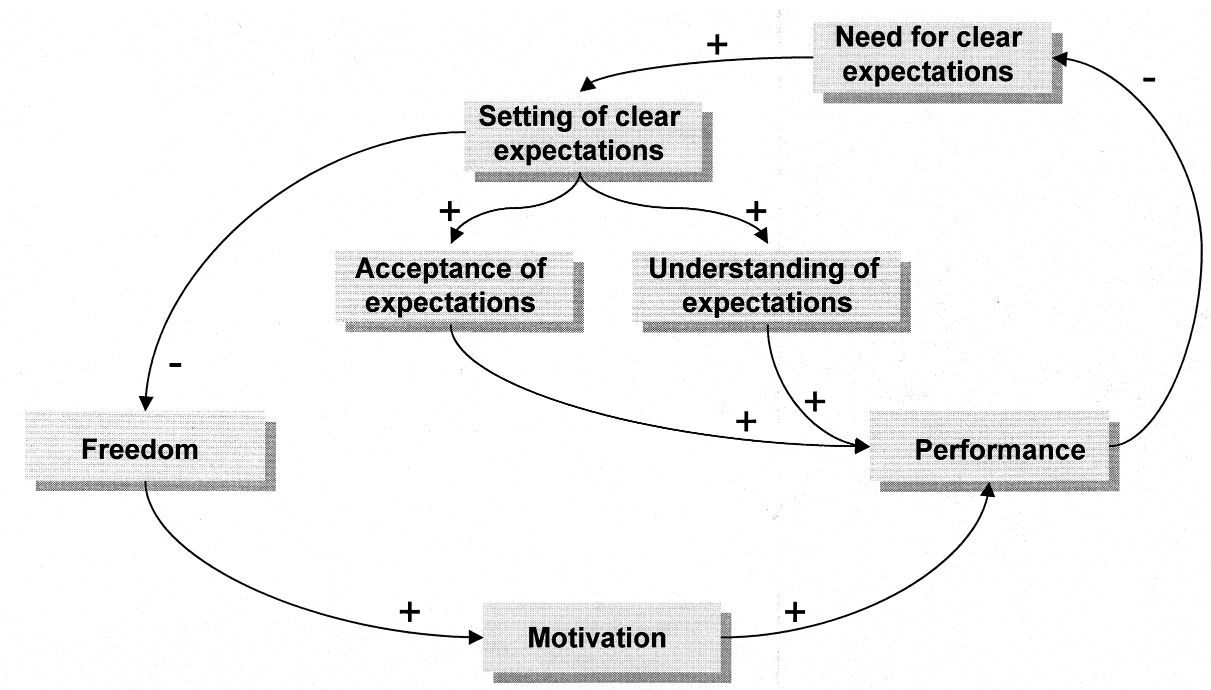

Figure 2. A More Sophisticated Systems View of Performance.

understanding phenomena in systems. On the technology level we need tools to understand systems without using cause analysis at all. To date, the focus has been on cause analysis so there is an absence of such tools in the technology.

The Myth of Performance Gaps

There is a delicate relationship between problem definition and problem solution. In defining a problem we use mental models to describe it. A problem definition is always based on underlying assumptions that might prevent us from seeing alternatives.

Einstein said, "Without changing our patterns of thought, we will not be able to solve the problems we created with our current patterns of thought." The meaning of this insight cannot be overstated. It tells us that the creative solution of a problem might be excluded "per definition" of the problem. It is hidden in the alternatives that are invisible because of the way the problem is defined.

In all the cases where this is true it is very unlikely that we would define a gap between current and desired performance. Nobody knows what the desired performance looks like. Only the creative overcoming of underlying assumptions might make this new performance opportunity visible. And the view may be only a partial one at the beginning of the improvement process. It will need to go through several iterations to reveal the complete picture of new opportunities arising from new solutions.

Far from being a precise definition of a performance gap, in many cases defining the problem itself is an iterative process. Creative solutions make us see possible performance more clearly. The better we understand what performance is possible, the easier it is to come up with appropriate solutions.

We must remember that models and assumptions are abstractions. The reality of problems in organizations is always messier. One way to take care of the mess is to build iterations into our methodology. These iterations must be more than a quick fix shown as two additional arrows in some kind of graphic that combines evaluation with every other process step. Iteration is at the very heart of the methodology. It is the only way we can take care of the limitations we all carry with us simply because we are human.

Masters Statement

What advice would I give someone on the path to becoming a master of his or her field?

The first step is to specialize in a very narrow field and dig as deep as possible. After some time the knowledge can be transferred to other fields of expertise. As the transfer progresses, the integration of new knowledge becomes easier. The knowledge connects with more and more knowledge of other related fields, and, all of a sudden, you are an expert.

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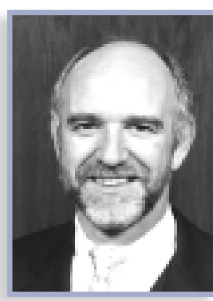

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