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FROM MECHANISTIC TO SOCIAL SYSTEMIC THINKING

A DIGEST OF A TALK BY RUSSELL L. ACKOFF, BY KELLIE T. WARDMAN

Each of us has a theory of reality, a concept of the nature of the world which is referred to as our worldview. Our worldview is the cement that holds our culture together; we absorb it by osmosis in the process of acculturation. We are currently in the early stages of a tremendous change in the dominant worldview—a shift in age as large in its implications as the movement from the Middle Ages through the Renaissance to the Machine Age. In order to understand the change we are experiencing we need to look more closely at the philosophies and ideas that have shaped our current view of the world and the shift in thinking that is required as we move from the Machine Age into the Systems Age. To understand the challenges we face requires a historical perspective that traces the evolution of Western thought from the Middle Ages to the present.

The Nature of Man and His Environment

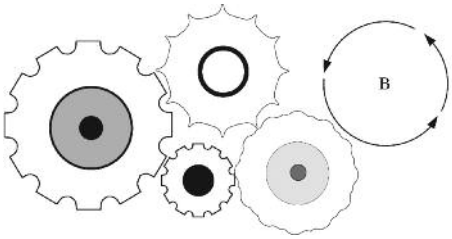
Our story begins over 1000 years ago, in the Middle Ages. Life expectancy was 27 years, 40 percent of the children did not survive infancy, 95 percent of the people never traveled more than four miles from their place of birth, and people lived in abject poverty. Given these bleak conditions, there was an intense focus on spirituality and the afterlife; this life was considered preparation for the life to come.

The conversion from the Middle Ages to the Renaissance was sparked by the Crusades and the opening of trade in the city-states of Italy. These events brought different cultures in contact with one another, and that, along with improved living conditions, sparked a renewed interest in life in the here and now—a desire to understand man and his environment.

The view of the world that developed during the Renaissance was based on three fundamental beliefs. The first was that complete understanding of the universe was possible. A European conference of leading scientists in the mid-19th century declared that by 1900, our understanding of the universe would be complete. The second tenet was that the world could be understood through *analysis*, by breaking things down to their most basic level. This led to a fundamental belief throughout every branch of human knowledge that everything and every experience is reducible to indivisible parts. The third element of this worldview was that all relationships can be described through simple cause-and-effect relationships: (1) A cause is *necessary* for an effect (the effect will not occur unless the cause does); and (2) The cause is *sufficient* for the effect (if the cause occurs, then the effect must follow).

Implications for Our Worldview

The commitment to cause-and-effect thinking led to three very fundamental doctrines which have permeated our thought for almost 400 years. The first was that if we want to explain a phenomenon, all we have to do is find its cause. To further explain that cause, we simply treat it as an effect and find its cause. But is there any end to this causal regression?



If the universe can be completely understood, there had to be a first cause—and this was the official doctrine as to why God exists. God is the only thing in the universe that could not be explained because God was the first cause.

The second consequence was that cause-and-effect thinking enabled us to have an environment-free theory of explanation. Since we believed that the understanding of the universe would be derived from the understanding of dyadic relationships (cause X's effect on Y) without the intervention of the environment, we had theories of explanation that looked at events within a vacuum. The third doctrine was that everything that occurs is the effect of an earlier cause; nothing ever happens spontaneously, or by chance. This is called determinism—each event is determined by the events that preceded it.

Isaac Newton was the first to synthesize these doctrines into a single image of our universe—*a hermetically-sealed clock*. He described it as a

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closed mechanical system, self-contained, with no environment. This assertion—that the universe is a machine created by God to do God's work—was preached by every religion in the Western world. Combine that with the biblical belief that man was created in the image of God, and you have the premise of a very interesting syllogism: (1) The universe is a machine created by God to do God's work; (2) Man is created in the image of God; (3) Man should also create machines to do his work. That was the origin of the Industrial Revolution.

The Industrial Revolution and the Machine Age

The Industrial Revolution, as the manifestation of our view of the world as a machine, brought about the mechanization of work. Work was defined in reductionist terms as the application of energy to matter to transform it. Based on this belief, Frederick Taylor developed a model of production that reduced work to its most basic elements, tasks so simple that no two people could do them at the same time. Those tasks that could be mechanized were assigned to machines, while the rest were done by hired labor. The machines and people were then aggregated into a network of elementary tasks dedicated to the production of a product—the modern factory. In the process of mechanizing work, however, we made people behave as though they were machines. We dehumanized work.

Dilemmas that Rocked the Machine Age

The decline of the Machine Age occurred as certain dilemmas appeared that challenged the validity of the worldview upon which it was based. The first chink in the Machine Age armor appeared with the realization that if everything we do is determined by something that preceded it (cause-and-effect thinking), then there is no free will. This flew in the face of the emerging belief in freedom of choice.

In 1923, a young German physicist named Werner Heisenberg came out with an incredible finding: the more accurately you can determine one basic property of an atom, the less accurately you will be able to know its other properties. For example, if you know the atom's mass, then you cannot determine its energy. His finding challenged the belief that the universe can be completely understood. Similarly, John Dewey's classical book *The Quest for Certainty* said that understandability of the universe is an unattainable end but an ideal we can continuously approach.

The dilemma that finally broke the back of Machine Age thinking, however, was the emerging understanding of systems that was anticipated by the publication of Norbert Weiner's *Cybernetics* in 1947 and realized in von Bertalanffy's 1954 book, *General Systems Theory.*

The Systems Age

Why did systems break the back of Machine Age thinking? It has to do with the fundamental characteristics of systems. A system is a whole which consists of a set of two or more parts. Each part affects the behavior of the whole, depending on how it interacts with the other parts of the system.

Also, the essential properties that define any system are properties of the whole which none of its parts have. For example, the essential property of an automobile is that it can take you from one place to another. No single part of an automobile—a wheel, an axle, a carburetor—can do that. Once we take a system apart, it loses that fundamental characteristic. If we were to disassemble a car, even if we kept every single piece, we would no longer have a car. Why? *Because the automobile is not the sum of its parts, it is the product of their interactions.*

To understand a system, analysis says to take it apart. But when you take a system apart, it loses all of its essential properties. The discovery that you cannot understand the nature of a system by analysis forced us to realize that another type of thinking was required. Not surprisingly, it came to be called synthesis.

Synthesis vs. Analysis, Understanding vs. Knowledge

Synthesis is exactly the opposite of analysis. The first step of synthesis is to determine the larger system of which the system to be explained is a part. The second step is to try to understand the larger system as a whole. The third step is to disaggregate the understanding of the whole into an understanding of the part by identifying its role or function in the containing system.

Analysis, on the other hand, reveals structure—*how* a system works. If you want to repair an automobile, you have to analyze it to find what part isn't working. Synthesis reveals understanding—*why* it works the way it does. The automobile, for example, was originally developed for six passengers. But no amount of analysis will help you to find out why. The answer lies in the fact that cars were designed for the average American family, which happened to be 5.6 at the time. Cars are now smaller in design because the average family size is 3.2.

The Doctrine of Expansionism

When we substituted synthetic thinking for analytic thinking, the Machine Age began to die. Reductionism gave way to expansionism–the belief that although we may never reach a complete understanding of the universe, the larger the system we comprehend, the greater our understanding. The man who was first responsible for this transformation was Arthur Singer, Jr.

In 1898, Singer published what was later seen as

the most revolutionary article in science in the last 100 years. It addressed the issue of determinism and free will. In it he asked, "Is an acorn the cause of an oak?" Clearly it is not; if we throw an acorn into the ocean, a desert, or an iceberg, we will not get an oak tree. An acorn is necessary, but not sufficient. Singer called this relationship producer-product. Unlike deterministic thinking, which says B is determined by A, a producer-product relationship says that A is necessary but not sufficient to produce B.

What are the implications of looking at the world through a producer-product viewpoint, instead of cause-and-effect? First of all, the environment becomes important. If I want to explain an oak, I first look for the acorn which produced it. But there must also be a certain amount of moisture, soil, nutrients, etc. The producer-product viewpoint provides an environment-full, not environment-free, theory of explanation.

Secondly, producer-product thinking is not a replacement for cause-and-effect analysis; it is simply another way of looking at the world. Just as an orange looks different depending on which way you cut it, Singer showed that cause-and-effect is only one way of looking at reality. Because reality is multidimensional, there are an infinite number of ways to look at it, and every slice through it will give you a different view. Therefore producer-product is not an alternative to cause-and-effect, but the two are complementary. And when you look at it this way, free will, purpose, and choice are compatible.

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Business as a Machine or Social System?

Our view of business has been profoundly influenced by this changing worldview. During the Industrial Revolution, business was viewed as a machine invented by man to do his work. The "god" of early business was the owner who created it. There were no labor laws or restrictions, and the business existed to serve the owner's purposes—to make a profit.

The appearance of unions and the education of the workforce brought some change to the workplace, but more fundamental shifts were wrought by economic factors. The economy was growing so fast in the 1920s that even if an enterprise took all of its profits and reinvested in its own growth, it still could not grow as fast as possible. Therefore, business owners in the 1920s had to decide whether to retain exclusive control of their enterprises, constrain growth, and remain "god," or to share control with others who could contribute capital. Those corporations that survived went public to raise the additional capital so they could grow. Now the "god" of the organization was not one single owner, but a group of shareholders.

World War II brought yet another transformation to the workplace. Even as the bulk of the American workforce was drafted into the military, our industrial machine demanded greater productivity. This prompted a huge influx of women into the workplace, and for the first time in the history of enterprise, the workforce was not primarily economically motivated. Pay in the army was $21 a month plus an allowance for each dependent, which meant that dependents could live comfortably, though not luxuriously, while the primary supporter was in the service.

The people who went to work during this time were the first ones who did not have to work in order to survive, and therefore they had a different attitude toward work. They said, "If you want me to work, you're going to have to pay attention to me. I am not a machine that you can use as you see fit and discard when I don't serve your purposes. I am here because of patriotism and loyalty to a national cause." For the first time, management had to begin to think of the workforce as human beings.

The civil rights movement, women's liberation, revolt of the younger generation, and problems in the third world represented parts of systems claiming the system as a whole was not serving their interests. As a result of these forces, the nature of management changed dramatically. Our view of organizations, however, has not quite caught up. Most managers are still acting as though the corporation is a mechanism or an organism, not a social system. Although we don't normally treat machines as organisms, one legacy from the Machine Age is that we have a tendency to treat organisms as machines, and even social systems as machines. That has a very limited usefulness, but it is not nearly as useful as looking at a social system *as a social system*.

Communications in the Systems Age

The Machine Age had the Industrial Revolution as its counterpart. So what is the technological counterpart of the Systems Age?

Around 1850, we began to use electricity as the source of power. When we started to use it, we had to develop devices such as ohmmeters and ammeters to measure it for us. These instruments were not machines in the classical sense. They were observers, not producers, and had nothing to do with the application of energy to matter to change the nature of matter. Yet we called them machines.

Very shortly thereafter the telegraph was invented. Then came the telephone, wireless, radio, television, and laser. They also were not machines; they were symbol transmitters—communications tools. For years, however, we treated these inventions as

machines, as part of the Industrial Revolution. It wasn't until 1946 that we recognized that something fundamental had changed.

What we were doing, in effect, was building a whole new technology based on an arch that had three stones. Observation was on one side and communication was on the other, but we didn't have a keystone until 1946. Then the first electronic digital computer, the Univac, was invented. It was neither a communicator nor an observer. Although we called it a thinking machine, it wasn't really a machine because it did not apply energy to the transformation of matter. It was a symbol-manipulating device.

A remarkable professor of philosophy, Suzanne Langer, observed that these emerging sciences and technologies all had to do with the manipulation of symbols in one way or another. And as Langer turned attention to the processing of symbols, at the same time synthetic thinking began to emerge. So when you put all these things together instead of taking them apart, what do you get? What you get is a mind.

The first Industrial Revolution was about the replacement of muscle by machine; about the application of energy to matter to transform it. Now we have a whole new technology which is about the use of artifacts as a substitute for mind, because they can communicate and observe and think. And so automation, rather than mechanization, is the key technology of the systems age.

Our current managerial and administrative problems were generated by a world that operates as a social system; but we have been trying to solve them using approaches based on mechanistic or organismic views of the world. Continuation of this mismatch assures continued degradation of our quality of life—if not our standard of living.

This article is condensed from a talk given by Russell Ackoff at the 1993 Systems Thinking in Action Conference. The complete story is available on both audio and video through Pegasus Communications.

Russell L. Ackoff was widely recognized as a pioneering systems thinker. He taught at Case Western Reserve and The Wharton School, and served as chairman of the board at INTERACT: The Institute for Interactive Management. He wrote numerous books, including *Ackoff's Fables* and *Creating the Corporate Future*.

Note: *Gender-specific terminology (i.e. "man" for "humankind") was retained throughout the article to reflect the thinking of the times described.*

