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A NEW GENRE OF BUSINESS COMMUNICATION: HOW TO MAKE A BLACK BOX TRANSPARENT

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With this article, I am creating a new genre of business communication: how to make a "black box" transparent. For many managers and administrators, science and technology remain mysterious and even scary black boxes. Actually they are neither mysterious nor scary if you know how to open them, and see through them. This article shows you the method. On your part, you have to make efforts to follow the steps without skipping them. Once you have seen the black box transparent, you gain not only a more contextualized vision, but also the ability to organize interactive inventions among heterogeneous specialists in your organization.

In 1986, a NASA space shuttle exploded shortly after launch, killing all the astronauts aboard. NASA smokescreened the incident as an "accident", making it look like something unexpected and beyond control. NASA scapegoated "poor communication between administrators and engineers." NASA even succeeded in co-opting the mass media.

The critics at that time said that NASA must change, not its "procedures", but its "culture" in order to improve the "communication". Everybody was satisfied with this diagnosis.

But a deeper problem remained untouched not only by NASA but also by those who criticized NASA. The real problem was lack of science-mindedness among the administrators. If they had the most elementary basics of science, they could have perceived the likelihood of the catastrophe. Did they learn, in their elementary or secondary schools, that metals contract as temperature goes down? Even if they did not learn, they should have known this phenomenon by practical experience: to loosen a metal bottle cap on a glass bottle, you heat the cap.

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The atmosphere temperature at the space shuttle launch site was not high enough to avoid contraction of metal parts along the fuel line, and therefore fuel leak would occur. Anybody could deduce it with "scientific common sense". In fact, in the 1986 incident, the engineering firm who designed and built the shuttle refused to sign the clearance document for the launch because the weather was cold at the launch site.

Many managers and administrators consider basic science knowledge as unwanted "burden". But basic science knowledge is practical and useful, especially in tasks such as facilitation of interactive inventions. Two examples of interactive inventions are given here as illustrations. (1) creation of quartz wristwatches by Seiko, which has beaten Swiss watches in the Neuchâtel competition in time-keeping accuracy in 1967; The Swiss authorities panicked, did not publish the result, and discontinued the time-honored competition in subsequent years. (2) elimination of spontaneous resonant vibration in "bullet trains" (shinkansen) in Japan, which spawned similar trains in other countries such as TGV in France. These trains ran at the speed of 300 kilometers per hour. A newer "magnetic levitation" train is under experiment in Japan since the 1990s, which makes 500 kilometers per hour.

(1) Several years before this event which shocked the wristwatch industry of the world, Seiko invented a quartz clock. Quartz had been used in radio transmitters and receivers because of its characteristics to maintain a stable oscillator frequency (wavelength). Oscillators have a circuit called "resonant tanks" in which the electric current swings back and forth, like a playground swing on which a child swings back and forth. On the playground swing, the frequency is determined by the length of the ropes. Another metaphor is the old-fashioned pendulum clock: the longer the pendulum, the longer the swing periodicity. In an electronic resonant tank, the electrons run back and forth in a circular wire path. A cheap way to make a resonant tank is to combine a capacitor and a coil, either in a circular wire path, in which the electrons run alternatively clockwise and counterclockwise, or to combine a capacitor and coil in series, in which the electrons run alternatively up and down. The periodicity is determined by the proportion of capacitor (which "holds" electrons) and the coil (which induces current from voltage. Before the invention of transistors, radios used vacuum tubes which, like lamps,

produced heat. Therefore when a radio is turned on, the temperature gradually rises and this affects capacitors' ability to hold electrons, and therefore "frequency drift" occurs.

But the ability of quarts slices, which is not affected by temperature, can maintain a constant "capacitance." Seiko incorporated this radio technology in a clock to maintain the frequency (wavelength) stability. But there was a drawback. The use of vacuum tubes made the device very heavy, because vacuum tubes produced much heat due to the transformers (which converted the power line voltage, usually around 100 volts in North America and Japan, but 220 volts in Europe) and rectifiers (which converted AC to DC by passing the current in one direction but blocking the current in the opposite direction. Transformers are very heavy because of their magnetic "core" around which wires are wound in two sets: The ratio of "primary" windings and "secondary" windings determined the voltage input/output voltage ratio. They consisted of layered metal sheets like plywood. Moreover, transformers produced much heat. (As you know, many transformers must be immersed in oil to cool them down.)

The first quarts clock (which was used in an Olympic game) was so heavy that it had to be transported on a small truck.

But Seiko had a great future vision: to put a quartz resonant circuit in wristwatches by minuaturing the components. Seiko used several methods. One method was to cut quartz in a zigzag way to compress into a small space the length needed for desired resonant frequency. By combining jewellery cutters with quartz experts who did not know how to cut quartz in a zigzag way, Seiko could put the quartz in the wristwatch. At that time the rotating time pointers (the long hand and the short hand) were still used instead of digital display, and the pointers were driven by an electric motor. Seiko was able to put a motor inside a wristwatch by taking the motor apart and putting the parts between the gear wheels. This was impossible in the Swiss watch making system where ready-made components were supplied by subcontracting firms.

(2) Another example of interactive invention was the elimination of derailing problems with high-speed trains in the 1950s, by utilizing aircraft technology to eliminate spontaneous resonant vibrations. This led to the creation of the "bullet train" (Shinkansen) in Japan, which stimulated the French TGV (très

grande vitesse) trains. Both Shinkansen and TGV attained the speed of 300 kilometers per hour. Subsequently the Shinkansen system and the TGV system were used in Taiwan and in China. But a newer system "magnetic levitation train" which does not touch the ground and therefore has no resonant vibration problem has been under experiment since the 1990s in Japan. The experimental train achieved the speed of 500 kilometers per hour on the experimental track some 100 kilometers west of Tokyo.

The interactive invention of Shinkansen in the 1950s happened as follows:

After the Second World War, the traditional trains were made to run faster and faster, causing frequent derailments. The train engineers believed that the derailments were caused by crooked rails. But aircraft engineers, who had designed the famous "Zero Fighter" airplanes during the Second World War, had seen the first versions of Zero Fighters fall apart in mid-air due to spontaneous vibration of wings, and had learned how to suppress spontaneous resonant vibration. It was decided to conduct experiments with small model trains. The railway engineers' approach was to run small model trains on small model tracks. But the aircraft engineers used the wind-tunnel concept, in which the model train stayed still and the rail moved on a large rotating vertical wheel turning around a horizontal axis. With this system it was easy to measure the swaying of rails. The experiments proved that the train vibrated at specific speeds regardless of how straight the rail was. If the speed was higher or lower than the resonant speeds, the train did not vibrate.

The idea of combining aircraft engineers and train engineers was a calculated foresight of the National Railway Minister. At the end of the war, he knew that engineers who had been drafted into the military service would become unemployed. He therefore collected bright engineers who had been in the military service. Among them were navy aircraft engineers who had designed the zero-fighters. Engineers who had held ranks of officers were purged by SCAP (supreme commander of allied forces). The railway minister lost about 1,500 engineers in the purge, but fortunately some engineers escaped the purge. (You might recall that von Braun, who invented rockets in Germany under Hitler, escaped purge and became a key figure in Los Alamos Laboratory in USA, where the atomic bomb and hydrogen bomb were developed. Some of the Nazi rocket specialists were captured by the Soviets, and contributed to the launching of Sputnik.)

Now that we have seen two examples of interactive inventions, let us turn our attention to the landscaping of human resources, i.e. how business firms can encourage interactive inventions, and how the firms can identify those who are innovative and those who are anti-innovative.

As a whole, individuals who prefer nonredundant complexity tend to be creative, and those who prefer redundant complexity are anti-creative. To sort out who are pro-creative and who are anti-creative, a long-term behavior observation is needed. As a quick preliminary test, you might use TOB Test which I designed. It is a pictorial gestalt perception test, and does not depend on languages. If you are interested in this test, let me know.