# Process Analysis De–Mystified: Lessons Learned From The Common Yellow #2 Pencil

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Students seeking technical education certificates or associate degrees present a formidable challenge to the instructor. The variety of life and work experiences each brings to the classroom makes it nearly impossible to select problem–solving case studies with elements familiar to every student. However, whether the students' backgrounds are welfare–to–work, displaced manufacturing laborers, retail clerks, homemakers, or managerial, all share a common characteristic: they have all used pencils. Using such a common object to teach the concepts of quality assurance and problem–solving concepts allows all students to participate on equal footing—all are experts on the use of the pencil. Its familiarity allows the students to concentrate on the concepts of the exercises, without having to learn the processes and nomenclature of the typical manufacturing case study. For the traditional academic student, these exercises are a good introduction to analysis for the purpose of observing and recording natural science labs.

## Essential Skills—Simple Technology

Process analysis skills are essential in a variety of courses: natural and social sciences, mathematics, engineering, and literature. Unfortunately, in many cases the students' concentration on learning the complex content of the course overwhelms them, and their written analytical reports suffer. While this paper concentrates on manufacturing process analysis, the methods can be used to help students understand the analysis process in other areas. The two simple exercises use both critical and intuitive thinking to allow for a comprehensive examination of unusual problems.

What is a pencil? It is one of the oldest tools in use. The earliest form of the pencil was the burnt stick used to mark rock shelter walls

with icons of hunter–gatherer societies some 50,000 years ago. It was probably pre–dated by the use of a stick to draw in dirt or sand, but nothing remains of those markings. Conservatively, it is safe to say that people have been making their marks for at least 100,000 years. The idea of the pencil has been with humankind for so long that it is essentially hard–wired into our brains, in much the same way as the urge to fetch is imbedded in the brains of Labrador retrievers. Any infant with a grasp knows what to do with a crayon or marker; ask any mother who has removed red scribbles from the dining room wall. It is this deep understanding of the pencil that makes it such a valuable instructional tool. No one is afraid of the pencil.

Examine the pencil's characteristics. It has no moving parts. The structural parts are few: body, lead, eraser, and ferrule. Each part is essential to each of the others in ensuring the function of the pencil. Cosmetic choices are limited to paint and printing. So, what can go wrong with such a simple device? Plenty, as is shown in the following studies. The main point to remember is the pencil has primary and secondary functions, as a writing tool and as media; ignoring the effects of both these functions can result in major problems.

## Case Study #1: Message On A Pencil

Pencils were printed with the words "It's Not Cool To Do Drugs" and distributed to a group of junior high students enrolled in a drug abuse prevention program. As the pencils were sharpened, the message changed to "Cool To Do Drugs" and finally to "Do Drugs."

Class discussion begins with the question, "What is the function of this particular pencil?" We hold a firm paradigm of what a pencil is, physically and functionally; in this case, the pencil's primary purpose is to educate, the ability to make a mark is secondary. The medium is the message, so to speak; this medium, while a perfectly good pencil, fails miserably at the primary function. This observation is an excellent example of the dictum "quality is what the customer says it is." The directors of the program could just as well have bought key chains, buttons, hats, or any other small item imprinted with the message. Their intent was to convey a message, not to provide students with a writing instrument.

Next, examine the process of manufacturing the pencil, with emphasis on finding the point where the mistake occurred. This technique is called reverse engineering and is one of the most valuable ideas in problem identification. Thinking backward through a process is always valuable; it leads to insights into the design of the product. Identify the point at which the problem was created and devise a method of preventing it permanently. Poke–yoke, or mistake–proofing, is another basic technique in process analysis.

## Case Study #2: Recycled Material In Pencils—Failing At Doing Good

The following aspect of the pencil surfaced in a training program for displaced workers. We had just finished the "message" study when a student asked, "What about rubber pencils?" I asked for an explanation. The student held up a yellow pencil and flexed it. He was unhappy with the product because it could easily be bent to such a degree that the lead would break in the middle and then fall out as the pencil was sharpened. The class examined his pencil and found that the body was not made of wood but of a small–celled foam material. It had the texture and weight of a wooden pencil but evidently not the strength.

Many pencils are made from recycled materials, such as plastics, currency, and blue jeans. Use of these materials results in lower cost and improvement of manufacturing efficiencies as well as being ecologically correct, but the structural integrity of the pencils is compromised. However, even though the plastic material looks and acts like wood, the properties are different. What could be done to overcome the problems created by this substitution? How can this type of pencil be tested by the designers to ensure proper function? Again, a paradigm surfaces: pencil leads are hard and brittle, and so they break within a flexible body. Discuss the possibility of creating a flexible pencil lead, and a subset of problems surfaces—pencil lead with the material properties of an eraser.

Do not expect a complete solution to this problem from the engineering standpoint. There is none. Instead, examine the economical aspects of this case. Does it matter to the customer if the lead breaks? Aren't most pencils lost, discarded, or broken before the pencil is

sharpened to half–size? If so, why not put lead in only half the pencil? Examining customer's patterns of use is a marketing basic, and so another area of business is examined. The pencils are packaged as seconds or overruns. Does the packaging give fair, if hidden, warning to the customer that the pencils are defective? Business law now enters the arena.

Discussion of these case studies covers a full range of quality system principles: pre–production analysis, documentation, customer service and expectations, process analysis, reverse engineering, and statistics. It can easily veer off into any area of business management and industrial engineering you wish. The simple #2 yellow pencil contains a wealth of information concerning how we make, sell, and use products; these lessons give the student a full understanding of these concepts, and this knowledge can be transferred to more complex processes. For continued fun with process analysis, pick up a matchbook.

## Biography

Debra L. Lauth has tripped lightly on the nontraditional path for five years since losing her job due to a manufacturing plant shutdown. After twenty–five years in production and quality assurance, she took the plunge into the academic world at Wright State University—Lake and earned her AAS in Mechanical Engineering Technology. She will attain the Holy Grail of a BS degree in Organizational Leadership in spring of 2001 at the same fine institution. She now serves as a custom training consultant, curriculum designer, and instructor for the Business and Industrial Development project at WSU—Lake, specializing in quality assurance and job skills development. In her free time (!), Lauth researches workplace sociology and human information processing styles, gardens, cooks with fire, and wanders aimlessly in the woods. She may be reached by e–mail at debra.lauth@wright.edu.