Engineering Systems

Byron A. Ellis – July 14, 2017

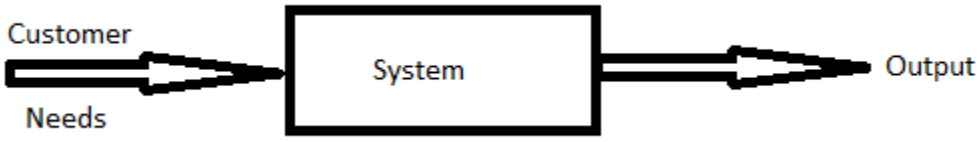
Often there is a lack of understanding as to what an engineering system is. Many confuse the performance of individual system elements with the performance or outcome of the system. "A system is a set or arrangement of interacting elements so related as to form an organic whole" (Menkes & Baldo, 1973, p.2).

The International Council on Systems Engineering (INCOSE) notes, "A system is a construct or collection of different elements that together produce results not obtainable by the elements alone. The elements, or parts, can include people, hardware, software, facilities, policies, and documents; that is, all things required to produce system-level results."

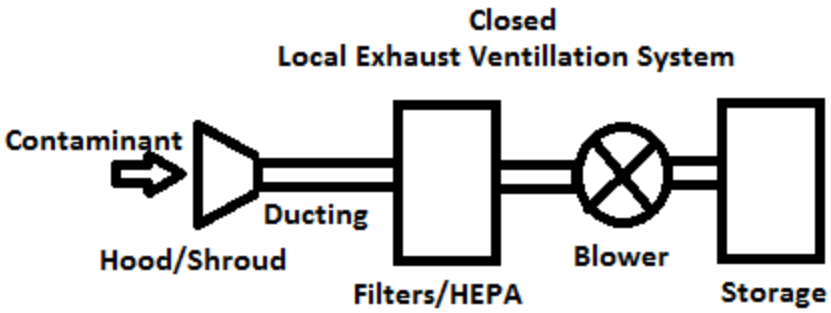
A system is an orderly grouping of interdependent components linked together according to a plan to achieve a specific objective. INCOSE points to Rechtin (2000), who stated that the value added by the system, beyond that contributed independently by the parts, ***is primarily created by the relationship among the parts; that is, how they are interconnected.***

We understand a system by visualizing its boundary. According to Menkes and Baldo (1973) whatever lies within the boundary is called the system. The parts of a system can be physically attached or remote from each other. Analysis of a system requires disaggregating the whole system into its parts.

Systems can be open or closed. The most straightforward configuration of a system is:



The characteristics of a system are the organization, interaction, interdependence, integration, and central objective. For instance, local exhaust ventilation (LEV) used to control hazardous dust or vapors in the workplace is a system involving a shroud or hood, duct or conduct, air filters, vacuum/blower, motor, and storage container, see image below. The design of LEV is to capture an emitted contaminants. It captures the contaminant at or near its source before it has a chance to disperse into the workplace air (OSHA).



LEV is an engineering system designed to reduce employee exposure to airborne contaminants (dust, mist, fume, vapor, gas) in the workplace by capturing the emission at source and transporting it to a safe emission point or a filter/scrubber.[1]

The effectiveness of LEV depends on a leak-proof hood/shroud, the adequate flow rate of air through the system, ducting without eddy currents and inefficient flow, high-efficiency particulate filters, and capable blower with totally enclosed fan cool (TEFC) motor. The material of construction must be compatible with the extracted contaminants.

References

Menkes, S. B., and Baldo, A. F. (1973). Analysis and Response of Linear Systems, The City College of New York.

Retchtin, E. (2000). System Architecting of Organizations: Boca Raton, FL. CRC Press.

[1] Local Exhaust Ventilation Guidance