
Improve Your Knowledge (IYK)

Functional Diagrams and Reliability Diagrams: Are there differences?

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In our recent consultations, we are faced with the problem to be some confusion regarding the functional diagrams and reliability diagrams. In this paper, we try to show, with a simple example, the difference between them. We believe it will help, especially those who enter in engineering systems (aeronautical or not). We will also speak about physical diagrams.

Companies using the methodology of Systems Engineering and Analysis (SEA), in diffusion process in Brazil, usually pass through development experience of these diagrams.

Early in the life cycle of a system, that is, the Conceptual Phase, we have contact with the functional diagrams.

The conceptual phase, by the way, is the most important phase of the life cycle. It is in that phase that we identify the requirements to be allocated or entered into the system design.

These requirements can be condensed into three large groups: customer/user requirements, certification authority requirements and requirements of the company developing the system.

Customer requirements are linked to the functionality of the system, in terms of operational performance and logistical technical support.

The requirements of the certification authority or certifying agent are focused on system safety.

Reliability is an important factor for both the operational and the definition of the logistic technical support of the system.

With these requirements, it is developed, still in the conceptual phase, a functional analysis, seeking to identify the system functions, both operational and logistical, and through functional diagrams, to see how these functions are linked in order to achieve the objective of system.

We consider here a system of our daily life, to show that the methodology of the SEA is General, i.e. does not apply only to the aerospace world. The system chosen is the one that we see in apartment buildings or commercial buildings. This is the pumping system of water stored in a reservoir in the soil of the building, leading to reservoirs at the top of the building (top reservoir), to be distributed to users.

The first step is to identify the functions. They are:

(F1) pumping water from a reservoir, forwarding it to a reservoir at the top of the building (top reservoir);

(F2) Check by means of a sensor, the water level position in the top reservoir;

(F3) Back to pump water to the top reservoir if the sensor indicates that the minimum water level has been reached; and

(F4) Stop the pumping of water if the sensor indicates that the established maximum level has been reached.

Let's go to the functional diagram of the system (fig. 1).

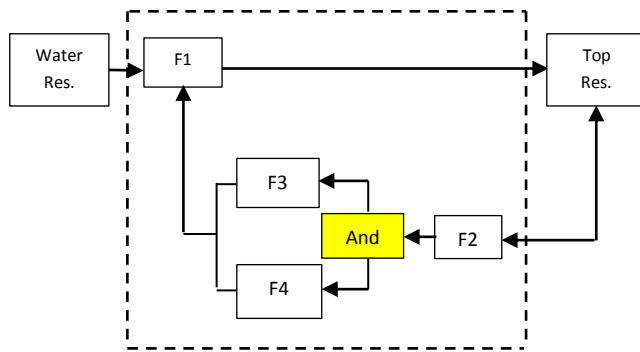


Fig. 1 – Functional Diagram

Important detail: *note that the system to be developed is the part inside the dashed rectangle. The reservoir and the top reservoir do not belong to this system. They are items that were already in the building.*

Similarly, the power supply to the system also does not belong to this system, since it was already available in the building. If we were dealing with an aircraft, the power would belong to the system because it would have to be developed with the rest of the system.

Note also that, when developing the functional diagram, we're not concerned whether or not redundancy for pumping.

Note also that F3 and F4 are after an And gate, indicating that these two functions have to be present. If one fails, the system will lose the control of the F1 function (pumping).

It's easy to see that operate with two water pumps will increase the reliability of the system. In fact it is what usually makes. Here we go for the reliability diagram (fig. 2).

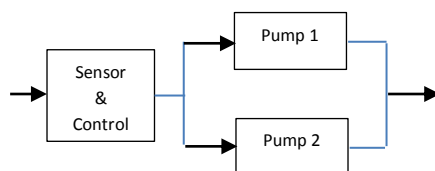


Fig. 2 – Reliability Diagram

There is a remarkable difference between the reliability diagram and the functional diagram. Note the pumps in parallel. In the language of reliability, this means that the system will continue operating if one of the pumps stop working.

To complement this IYK, we present the physical system diagram (fig. 3).

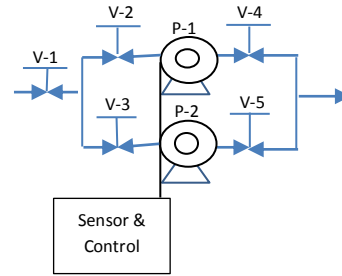


Fig. 3 - Physical Diagram

Where V_n are valves¹ and P_n are bombs.

As it turns out, the physical diagram is drawn with representative symbols of the system's physical components, showing clearly the interconnection of these components. It would be as shown in the system's maintenance manual.

The space is small, but we believe that there has been enough to show that there are differences between the functional diagrams and the reliability diagrams.

See you.

References:

- (1) BLANCHARD, Benjamin. S - FABRICKY, Wolter J. Systems Engineering and Analysis. USA: Prentice Hall, 4. Ed., 2006.
- (2) MODARRES, M. Reliability and Risk Analysis. Cincinnati - Ohio (UA): Marcek Dekker, Inc., 1993.

¹ For simplicity, we are considering the valves as ideal componentd.