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I wrote the following many years ago (when all operators were male). Since then another generation of chemical engineers have reached the middle of their careers. If you are one of them, or younger, you may already know what I have written, or perhaps not. I have made a few changes in wording but the message is unchanged. Comments will be welcome.

THE MAN IN THE MIDDLE

The diagram illustrates a common situation on our plants.

When the alarm sounds and lights up, a man is expected to close a valve. For example, the alarm might be a high level alarm on a tank and when it sounds a man is expected to close the tank inlet valve.

We know the reliability of the alarm fairly accurately. If it is tested regularly, and sounds once/year “in anger”, then about every 50th time that it should sound, it may fail to do so. If we are dissatisfied with this performance, it is easy to make the alarm more reliable.

We have a rough idea of the reliability of the valve. We know that on a typical duty, about once in 50 years, turning the handle will not stop the flow, though the figure will vary a good deal between different duties. Again, if we are not satisfied we can, at a cost, improve the reliability.

What about the man in the middle? How reliable is he? In the past our views have swung between two extremes.

In past times (that is, more than a generation ago) most managers assumed that he should always do what he was expected to do, and if he did not he ought to be sacked or reprimanded, or at least given extra training.

In more recent times (that is, starting a generation ago) many managers have assumed that he could not be relied on and that we ought to have an automatic system: The rise in tank level should close the inlet valve automatically.

Both these views are equally unscientific. What we should say is, “How often will the man close the valve?”

Before we try to answer this question, let us list some of the reasons why the man may fail to close the valve when the alarm sounds.
1 Lack of training or instructions — he may not know what to do.

2 Lack of physical or mental ability — the valve may be too stiff or out of reach or he may be unable to understand his instructions.

3 Lack of motivation — he may not appreciate the importance of closing the valve or cannot be bothered to do so.

Let us suppose that we have eliminated all these causes of failure by suitable training, instructions, design and so on. The man knows what he should do when the alarm sounds, is willing to do it and capable of doing it. Will he always do it?

The answer is No, as there is a fourth reason for failure which is harder to remove: particularly if people are busy or under stress or if they are distracted by other people, they will occasionally forget to carry out a routine task or carry it out wrongly — they may forget to close the valve or close the wrong valve. How often?

Many control designers usually assume the following when designing plants:

(a) If rapid and complex actions by an operator are necessary to avoid a serious incident, such as an explosion, his failure rate may be high and we prefer not to rely on the operator but to install a fully automatic system.

(b) In deciding whether or not to install an automatic system in a busy control room, we assume that perhaps once in ten times a man will fail to close the valve within, say, 10 minutes or will close the wrong valve. This seems a high failure rate but remember that other alarms may be sounding and the operator has to decide which to deal with first, the phone may be ringing, people may be demanding permits-to-work, and so on. If the operator knows that responding to a particular alarm is very important he will be more reliable, but not all alarms can be labelled “Important”.

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