

fundamental basis, we have the natural result; a lack of co-relationship between the different functions of train operation, which necessitates the framing of rules to meet conditions, which in themselves are a natural consequence of this neglect of principle.

The history of the development of our present system of operation is instructive. In the beginning trains were operated on American railways, by time table. Each train was scheduled, and meeting points with other trains were specified. If a train became late, the opposing train had to wait at the specified point; every train that became late caused every other train interested in its movement to lose time also. This was unimportant when there were but few trains, but as the number of trains increased it meant serious loss. To overcome this, messages were sent to the train crews changing the meeting points. These orders were simply messages, not in any prescribed form, and not requiring any acknowledgement from the men to whom they were sent. There was no guarantee that the messages had been received. This naturally led to serious accidents, and it became necessary to provide some means whereby the dispatcher would know that the message had been received by the trainmen of the train, the right of which was being restricted, before issuing instructions conferring right on some other train. This led to the requirement that the order should be signed by the man in charge of the train and repeated back to the dispatcher and O.K'd by him before the order could be acted upon. The wording of the orders was not prescribed, each dispatcher composing orders in his own words, and addressing each train interested separately. The consequence was that the orders were misunderstood by the different train men.

The American Railway Association finally took this matter up, and formulated the standard code. This prescribes the form of the order, and makes it necessary that each train interested receives the order in the same wording. This is delivered simultaneously to all points where the trains are to receive them.

This did not furnish the safety expected. Train men would mistake the meeting point. The middle order was then introduced which requires that a "meet" order should be sent to the two trains, and in addition to the operator at the station, at which the meet was to be made.

As traffic increased, and was irregular, scheduled trains were not sufficient to move the business. It became necessary to send out additional trains, known as extras. These trains were moved by orders, and had to keep out of the way of scheduled trains. They were therefore slow. In order to overcome this delay, trains were sent out as sections of regular trains. These ran on the rights of the scheduled trains. Preceding sections display signals on the engine, indicating that there are sections following, these signals are simply a green flag carried by the sections in advance, the final section having no distinctive mark. Any number of sections of a regular train can be run. This has not added anything to the safety of operation. Take a concrete example.

No. 56 is a regular train due at A at 12.35.

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A is the scheduled meeting point for these two trains.

No. 56 is running in two sections.

No. 176 is a regular train running in three sections.

The even numbered trains are north-bound, the odd numbered trains are south-bound.

The following order is issued to 1st No. 176, 2nd No. 176, and No. 55.

"First and second No. 176 will wait at A until 12.35 p.m. for No. 55. No. 55 has right over 3rd 176 D to E."

No. 55 makes A on the order and is in on the siding.

First No. 176 goes at 12.45 displaying green flags.

First No. 56 goes at 12.50 displaying green flags.

Second No. 56 goes at 12.55 displaying no signals.

The crew of No. 55 checks them as follows.

First 176 checked all right, first 56 checked as second 176, second 56 checked as No. 56, No. 55 pulls out and meets 2nd 176 on main track.

No rule has been violated in this case, and the mistake on the part of the train crew of 55 is one due to the system and not to the carelessness of the men.

The above is a rough outline of the development of the present system of train operation by Standard Code. There does not seem to have been any investigation of the principles underlying the question. It appears simply to be a sporadic growth. When a particular condition arose, means were adopted to meet this condition. The engineer has had little or nothing to do with the development. Whether these means have been adequate or not can be seen from the table below. This is a compilation of the accidents due to collisions for a period of a year and one-half, taken from the United States Accident Bulletin. During the period covered by these, there were a total of 6,412 collisions. Can there be any doubt, with this weight of evidence, that the method of operation under the Standard Code, is unsafe and uneconomical.

In contrast to the above, the history of the development of train operation in Europe is striking. It was at once recognized that from the nature of a railway, (that is that all trains much of necessity occupy the same path), some means had to be provided to prevent two of these trains attempting to occupy the same space at the same time. The method adopted was to divide the line into sections, each of which was put under the control of a signal man. This man supervised the operation of his section alone, and could have but one train in the section at any one time. Trains had no time table rights, they simply had the right to run through one section, the right to proceed being given or withheld, depending on whether the succeeding section was occupied or not, or depending on whether a meeting was to be made with some other train or not.

At first trains were admitted to the section provided the preceding train had departed at least ten minutes previously. This refers to double track and to following trains only, this method was found wanting, in as much as it was impossible to tell positively that the section was clear, through to the next signal man, as a train might have stopped in the section and out of view of the signal man. To overcome this apparatus was installed, between the succeeding signal men, making it necessary for the men at both ends of any one section to communicate with each other before a train was admitted. One train not being allowed to enter a section until the previous train had passed out of the section. A train would continue to run until entrance to the next section was refused. There was no stopping for orders. If one train had to meet another, they would both continue to run until held by the non-receipt of a signal to proceed, and the meet made at this point. The principle involved being that of the impenetrability of matter. Collisions are impossible where it is impossible to get two trains on the same section of track at the same time. This method was developed by engineers.

Bearing in mind that there are three elements in the problem to be considered, namely safety, expedition in the movement, and the lowest possible cost consistent with these, the question is what method of operation will produce a maximum of the first two, and a minimum of the last.