at the beginning again and make exhaustive detail studies, using all the standard published material in which we have confidence along with our own observations. We do this in order to arrive at constants to be used for our own purposes. A set of curves of speeds taken from the studies on the art of cutting metals has proved very practical and useful. We merely convert the hardness numbers of metals used in those studies to the hardness numbers of our own particular metals. All our preliminary time study men check their feeds and speeds in operation against these curves and are thereby able to get good temporary data very quickly.

These standard data are absolutely essential to us in estimating, months in advance of bringing out a new model, just what it will sell for. On a particular new model figured this year there was one dollar difference between the estimated direct labor rate and the final set time study rate. The estimate was made before the work was in process, but only after fairly permanent designs had been submitted and a pilot model built. The same type of data is used by the mechanical or methods department in selecting machinery and designing tools. They are used to determine how much machinery and how many tools will be required to produce a given number of parts. Through contacts with the time study department, there has grown into the methods and equipment department an almost unconscious appreciation of the exact time needed to perform certain duties. The manufacturer's guarantee of how many pieces a machine will turn out is valuable information also, and used extensively by the methods and equipment department.

We have also been working for a year on a means of estimating the amount of factory supervisory labor that will be needed on a given model. This is done by getting the standard time from the time study department and applying to it a standard base rate for this class of labor. For several years, with very little change, we have used a standard base rate for various classes of labor. By this means we can get an overhead rate, and also set quotas for non-productive labor. We have found that we cannot base overhead rates on the payroll unless the payroll is based on standard time.

Once that is arrived at, we have found that, no matter how many changes there are in a department, the supervision quota will revert to a minimum line as soon as the changes are over. This has enabled us to find the cause of extensive supervision excesses above this minimum time and to evaluate them. For example, in one department it cost $25.25 non-productive excess to put one dollar of new piece price into complete operation. So throughout our whole organization we can find what the effect of our engineering changes is on our productive and non-productive department expenses.

We can get the number of productive workers for a department through our standard times and product schedule; multiply this by a standard coefficient and obtain the amount of non-productive labor; add a fixed number of persons for the salaried group and obtain a standard labor force. Excesses above this must be due to some extraordinary cause. This plan is in direct operation at the present time.

As I have stated, I think the most disturbing thing we have to confront is this need for temporary rush studies. The welfare of the worker and a great deal of money depend upon the way the work is started. Therefore, we should not be content with temporary rush studies nor try to make them the basis for standard data. The whole job should be restudied slowly and in detail, and the results of these studies used for setting standards

I am very glad that men like Mr. Thompson persistently and continuously hold to the early scientific management principles of time study. We need to remember that these scientific principles are fundamental; to realize the importance of scientific time study and standards, and to establish both.

I am looking forward to a meeting at which we can discuss time study for three days because it is so fundamental to industry today. I am frequently surprised to go into a large industrial concern and see the work of a small group of time study men unchallenged and unquestioned. The employment of labor, routing, even the installation of equipment involving huge investments, are all based on the workers' performance, and time study is its measure. The economic and human effects of the improper use of this measure are so important that every industrial executive should be interested in improving its technique. Let us generally make time study scientific as was intended at its inception.

Education for Management[1]

How Can Schools of Engineering and Schools of Business Correlate Their Curricula and Research More Effectively?

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IN ATTEMPTING to discuss the possible correlation of instruction and research in the fields of engineering and business, it will be helpful to review some very well known facts which should nevertheless be clearly in our minds as we attempt to plan educational programs for the future.

As is well known, the engineering schools are much older than the schools of business. The War of 1812 sharply directed the attention of young America toward manufacturing. Shortly thereafter an important technical school came into existence in Rensellaer Polytechnic Institute, which was established in 1824 with a one year course. With the development of American railways this institution added a three year course in civil engineering in 1835. Increasing interest in manufacturing in this country registered itself in further provision for technical education in the establishment of the Lawrence Scientific School at Harvard, and the Sheffield Scientific School in Yale, both in the year 1847. About the same time railway development in the Middle West brought the organization at the University of Michigan of a course in civil engineering. Massachusetts Institute of Technology was organized in 1865. Even the University of Illinois at the outset was called the Illinois Industrial University, thus showing the emphasis of the education of the early period of American history. Not until the year 1885 was the name of the University of Illinois changed to its present title.

The schools of commerce on the other hand have, in the main, been established since the opening of the present century. The Wharton School was established in 1881, but no other followed until 1898, when such schools were established in both the University of Chicago and the University of California. By 1900 there were seven schools of business in existence. Today there are over 180 departments, divisions, or schools which offer courses in accounting and business administration.

What is the explanation of the early emphasis on technical education and the recent growth of business education, which is one of the most significant educational developments of the present century?

During the earlier period to which reference has been made, it was logical that there should have been much emphasis upon technical education. We were at that time trying to develop manufacturing in this country and to build railroads to carry our rapidly increasing commerce. Even in our early colleges of agriculture the greatest need was that of improving the character of our grain crops and of our livestock. In the early days the corn crop consisted of too much cob and too little corn; the cattle of the period might have been thought to be the lineal descendants of the lean kine of Pharaoh. A western editor describing the swine of the early sixties in what was then the "Middle West," stated that a "typical porker" was one that could put its nose through a crack in the rail fence and rout out the second row of potatoes.

The emphasis, then, to improve production was properly placed, whether that production was concerned with machinery for factory or farm, or whether it was concerned with better grains, vegetables, or livestock.

The foundation was laid in this country for a remarkable record in the various fields of production when our Constitution prohibited any tariff between states. This establishment of free trade over such an enormous territory, rich in natural resources, was destined to produce a very large manufacturing unit, thus bringing about a geographical division of labor on a scale which had

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