

CHARLES GOING

Charles Buxton Going was managing editor of *The Engineering Magazine* for many years. In this capacity he saw much of the early literature concerning industrial engineering and management developed, disseminated, and placed in practice. As a lecturer at the Department of Mechanical Engineering at Columbia University in 1908-09 he delivered a number of papers which were to serve as the foundation for a composite course in Works Management. In 1911 these papers were published in one volume under the title, *Principles of Industrial Engineering*. The book covers such topics as industrial organization, industrial ownership, nature and distribution of expenses, wage systems, materials, and philosophies of management. This is possibly the first book published with the term "industrial engineering" in its title and was probably influential in developing the early concepts of industrial engineering as a profession.

In his first few pages Going defines industrial engineering. This is of interest to us, in view of the many current attempts to define the field.

The Origin of the Industrial System

Industrial engineering is the formulated science of management. It directs the efficient conduct of manufacturing, construction, transportation, or even commercial enterprises--of any undertaking, indeed, in which human labor is directed to accomplishing any kind of work. It is of very recent origin. Indeed, it is only just emerging from the formative period--has only just crystallized, so to speak, from the solution in which its elements have been combining during the past one or two decades. The

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conditions that have brought into being this new applied science, this new branch of engineering, grew out of the rise and enormous expansion of the manufacturing system. This phenomenon of the evolution of a new applied science is like those that have been witnessed in other fields of human effort when some great change, internal or external, forced them from a position of very minor importance into that of a major service to civilization. Columbus could blow across the ocean in a caravel to an unknown landfall; but before a regular packet service could be run between New York and Liverpool navigation must be made a science. It has drawn upon older, purer sciences for its fundamental data--upon astronomy, meteorology, and hydrography, and later upon marine steam engineering and electricity; but out of all these it has fused a distinct body of science of its own, by which new practitioners can be trained, by which certainty, safety and efficiency of performance may be substantially assured.

Navigation is not merely making correct observation of the sun and stars, of lights and beacons, of log and lead; it is not merely directing the propelling and steering machinery; it is not merely knowledge of courses and distances; it is not merely storm strategy. It is the co-ordination of all these in handling the equipment provided by the marine engineer and naval architect, through the work of a crew of men.

In somewhat like manner, industrial engineering has drawn upon mechanical engineering, upon economics, sociology, psychology, philosophy, accountancy, to fuse from these older sciences a distinct body of science of its own. It does not consist merely in the financial or commercial direction, nor merely in running the power-plant or machinery, nor merely in devising processes or methods. It consists in co-ordinating all these things, and others, in the direction of the work of operatives, using the equipment provided by the engineer, machinery builder, and architect.

The cycle of operations which the industrial engineer directs is this: Money is converted into raw materials and labor; raw materials and labor are converted into finished product or services of some kind; finished product, or service, is converted back into money. The difference between the first money and the last money is (in a very broad sense) the gross profit of the operation. Part of this is absorbed in the intervening conversions, or, in other words, in the operations of purchase, manufacture, sale, and the administration connected with each.

Now the starting level (that is, the cost of raw materials and labor) and the final level (the price obtainable

for finished product)--these two levels are generally fixed by competition and market conditions, as surely and as definitely as the differences in level between intake and tail race are fixed in a water power. Hence, our profit, like the energy delivered at the bus bars, varies not only with the volume passing from level to level, but with the efficiency of the conversions between these levels. In the hydroelectric power-plant, the conversion losses are hydraulic, mechanical and electrical. In any industrial enterprise the conversion losses are commercial, manufacturing, administrative. It is with the efficiency of these latter conversions that industrial engineering is concerned.

The industrial engineer may have in his organization staff many mechanical engineers superintending special departments--design or construction, or the power-plant, for instance--while his own duty is to co-ordinate all these factors, and many more, for the one great, central purpose of efficient and economical production. He is concerned not only with the direction of the great sources of power in nature, but with the direction of these forces as exerted by machinery, working upon materials, and operated by men. It is the inclusion of the economic and human elements especially that differentiates industrial engineering from the older established branches of the profession. To put it in another way: The work of the industrial engineer not only covers technical counsel and superintendence of the technical elements of large enterprises, but extends also over the management of men and the definition and direction of policies in fields that the financial or commercial man has always considered exclusively his own. ...