ON THE TENDENCY OF LABOR SAVING TO INCREASE COMPENSATION COSTS

BY

LESLIE L. HALL

The purpose of this paper is to call attention to the general tendency of labor saving methods to increase compensation costs, principally because of the relative increase in accidents wherever non-hazardous payroll is diminished by the substitution of machines for men, and to suggest ways and means of making a thorough-going investigation of the subject.

During the past few years there has been much speculation as to the cause of the increase in compensation costs. Undoubtedly the marked increase in loss ratios, which was first observed under policies issued in 1921, was due very largely to the drastic rate decreases which became effective about that time as a result of using the abnormally favorable experience of the war years, as well as to the effects of the economic depression. The situation was so serious as to require concentration of attention upon immediate remedial action in the way of an adjustment of rates to fit the new conditions, and this necessarily operated to postpone a study of the depth and thoroughness required to determine definitely the underlying causes. Such a study would have involved many difficulties because of the obstacles that must be overcome in any attempt to isolate and determine the effect of the many intangible, overlapping and frequently conflicting elements contributing to the general result. But we have now reached a stage when it would seem desirable to return to this problem and devote further efforts to its solution. It is with the thought that this paper may contribute in a small way to open up avenues of investigation of one phase of the problem that it is presented at this time.

The elements causing increases in losses may, in a general way, be divided into two groups. Some tend to produce increases in the cost per accident independently of the actual rate of occurrence of accidents; others tend to produce absolute in-

creases in accident frequency. As examples in the first group, the following may be listed:

1. Amendments to the compensation laws liberalizing their provisions.
2. Increased liberality of awards on the part of adjudicating bodies.
3. An increase in severity of accidents due either to an increasing prevention of the non-serious accidents or to changes in industrial methods such as an increasing use of machinery.
4. A stimulation of malingering due to the increase of benefits to a point more nearly approximating the actual wage.
5. Higher charges for the services of physicians, hospitals and other medical items.

As examples of conditions causing increases in accident frequency, the following may be cited:

1. Industrial activity. The men in industry being pressed to increase production to the highest point, do not have an opportunity to exercise the thought and care that would be used if they were not working under pressure.
2. An increase in the carelessness of employes in industry. This may in part, be an aftermath of the war where men were exposed to such great danger that upon their return to industry, the risks seemed so slight as to be practically insignificant.
3. Desire for adventure. Under our present day civilization, this finds comparatively little outlet and the so-called recklessness may be simply a manifestation of the innate desire to get some excitement out of life.
4. Faulty educational methods. We are living in a mechanical age and if people generally are unfamiliar with mechanical and other present day hazards, they are not so well qualified to cope with them as would be the case if they knew more about them.
5. Readjustments of industry may increase accidents during the readjustment period because of the difficulty of employes adjusting themselves to the new conditions; also during periods of activity a host of unskilled employes enter industry, among whom the accident rate, because of lack of skill and experience, is abnormally high.
6. Labor saving methods, that is more efficient methods and the increasing substitution of mechanical for manual processes.

There are doubtless many other possible causes which could be included in the above groups but the foregoing appears to cover the more important ones. Some of these causes may be of only a temporary character, others of a semi-permanent character but eventually reaching a saturation point, while still others may be permanent but of decreasing importance.

Of all these causes, the one dealing with the constant introduction of labor saving methods has been given comparatively little attention. This seems strange when one considers that the compensation movement itself grew out of the change in industrial processes and relations that developed from the substitution of machine for hand labor. Our apparent indifference to the subject might imply the belief that industrial processes are now completely stabilized or that the changes are too slight to warrant general study and investigation. As a matter of fact, the contrary seems to be the case. Industry generally, during the past series of years has been forced to give a steadily increasing amount of attention to the control of labor costs. Industrial executives, engineers, scientists and inventors are giving the subject their constant thought. Even in trade and commerce and the offices of carriers writing this form of insurance, the problem is never lost sight of. Efforts in this direction have been along two lines which have a certain interrelation, namely, first an attempt to increase efficiency in production, second an attempt to replace labor where practicable by machinery or, we may say, by an increased mechanization of industry.

Efficiency as here referred to, consists in rearranging buildings, departments, machines and processes for the purpose of securing a more direct and rapid flow of materials, the elimination of non-productive labor or operations or other lost motion. Mechanization consists in doing partially or entirely by machinery, something which has previously been done by manual effort, either alone or with slight mechanical assistance. It is not suggested that this cause could be chiefly responsible for the sudden change in accident experience affecting industry as a whole which has been experienced during the past few years. Nevertheless, it is believed that it exists as a constant factor working towards increased loss ratios, which at times may be completely counteracted by the accident prevention and wage increases or at others may be augmented by one or more of the previously enumerated causes.

We find examples of mechanization wherever we look. We find it in the factory, on the farm, in construction work, in the mine, in the store, the office and even the home. Witness the almost innumerable automatic and semi-automatic machines in the factories, the tractor operated by one man and pulling several plows on the farms, the machines for building concrete roads, the undercutting machines in the coal mine, the package and money carrier systems in the store, the tabulating, sorting, billing and duplicating machines in the office and the vacuum cleaner, power washing and ironing machines in the home. These changes are constantly being introduced, but they come so gradually that the effect is not realized.

The writer has made some attempts to measure the effect of this constant evolution but because of the lack of sufficiently refined statistical data, the results in this direction have not been satisfactory.

Figures, presented herewith, which were compiled from the reports of the U. S. Bureau of the Census demonstrate the general effect. A study of these figures will indicate that the ratio of horsepower to man power in several important industries, taken for various time intervals, has shown a marked and very generally persistent upward tendency.

It is unfortunate that comparable figures for the next five year interval (1924) are not available. This is due to the fact that the mode of taking the census has been changed and the methods of tabulating the significant data modified.

It will be noted that in the case of the milling industry, there has been but little change in the ratio. This is an industry which has always been highly mechanized. Almost all of the operations are entirely mechanical, the men in the industry being almost exclusively engaged in seeing that the machines operate properly.

In the case of some of the industries, there is a decided drop in the ratio of horsepower to man power as between 1914 and 1919 but it will be noted that this drop was not due to any decrease in the horsepower, which continue to rise but rather to the very material increase in the number of employes. It will be recalled that 1919 was one of the years of inflation following the war period, consequently it would seem inherently probable that some of these industries were either working more than one

shift or else they were unable or unwilling to install mechanical equipment to cope with the demands for increased production. It will also be recalled that the experience under 1919 compensation policies was favorable. Attention might also be directed to the fact that the industries showing the higher ratios are in general, the more hazardous industries.

If figures comparable to those herein were available, they would not only indicate whether or not the ratios for these particular industries again exhibited an upward trend, but might also make it possible to ascertain, at least in part, whether or not there is any significant relation between these ratios and compensation loss ratios.

In any event, these figures demonstrate that over a substantial period of time, the tendency has been for labor to contribute relatively less to the productive powers of industry and machinery relatively more. This, as affecting compensation loss ratios, has a dual significance. These ratios may be regarded as a fraction, the numerator of which expresses accidents and the cost of compensating them, the denominator of which expresses the payrolls used as the measure of exposure. In considering the effect of this or any other tendency, consideration must be given to possible effects upon either numerator or denominator.

Substitution of machinery for labor may be considered as falling into three classes (a) where the substitution of machinery for manual labor involves a hazard to the employe distinctly less, (b) where it involves no material change, (c) where it involves a hazard distinctly greater. It is believed however, that for industry generally, the substitution makes for an increased hazard to the employe. Inasmuch as the substitution is intended to effect an increase in production or the maintenance of the same production with a decreased personnel, it may however, even in the last case not change the hazard per unit of production or even diminish it.

For purposes of analysis, it may be assumed that the general effect will be a diminution in the number of employes. In the class of cases indicated as "(a)", namely, where the substitution involves a reduction of hazard to the employe, the effect upon the numerator of accidents is twofold, namely a diminution of the average number of accidents per employe and a diminution of the number of employes, thus effecting a notable reduction. In

class (b), there is only the diminution of the number of employes effecting a reduction therefore, less marked than in the preceding class. In class (c), since the hazard per employe is increased and the number of employes is diminished, the result may be to increase or decrease the numerator, the two changes having a diametrically opposite effect.

In all cases, since the number of employes is reduced, there may be a reduction in payrolls, thus diminishing the denominator of payrolls. Hence in any case, owing to the reduction of the denominator, the net effect of the change may be to produce a mounting loss ratio, the probability of such an effect being greatest in class (c) which is believed to be the class most characteristic of industry generally.

It must be borne in mind, however, that a change from manual labor to machinery frequently involves an effect on the industry as a whole relatively insignificant. Machinery may be rearranged or conveyors installed to reduce manual transportation or trucking between various operations, sprayers or "guns" may be installed to apply finishes in place of the hand brush method. Any number of small changes such as these may be made, and though the importance of each is slight, taken in the aggregate, the effect on loss ratios may be considerable.

For example, a furniture factory doing all of its finishing by hand, may install paint "guns". The first question to be considered will be the effect on the losses in the finishing department. Applying finishes by hand is comparatively non-hazardous. There is some doubt as to the hazards incident to spraying.

Without attempting to solve this question, assume that the hazard per man exposed is the same with the spray method as with the hand brush method. The next question to be considered is the effect on the denominator. By use of the spray method, it will be possible to diminsh the personnel in the finishing department and still maintain production. Most of the accidents in furniture factories occur in the machine or mill department. That is, the mill department is the high hazard department while the assembling and finishing are of less hazard. In the case of such an industry, the losses in all departments would be spread over the entire plant payroll by reason of the use of a compensation insurance classification and rate contemplating the complete operation. As a result, the loss cost per unit

of payroll would be higher after the change because of the diminution of the non-hazardous payroll. If this diminution of payroll in the finishing department were material, the same result would occur even if the hazard per man with the spray method were less than with the hand method. This is obviously because the initial hazard of this department was much less than the average hazard of the factory as a whole. Consequently, while the reduction in hazard in this department would tend to reduce the average hazard per unit of payroll for the plant as a whole, the reduction of payroll in this department would operate more strongly to increase it.

This result could be counterbalanced by either of two things. Safety activities might reduce the accident cost in the plant as a whole in the same proportion as the payroll reduction occasioned by the diminished personnel, but there is no reason to believe that such accident reduction would be coincident with the payroll reduction. Wage increases might be made in an amount sufficient to absorb the reduction. There appears slight probability that increases to such an extent would be made because the employer would lose all incentive to incur the capital charges incidental to the purchase of new equipment if the entire savings effected by such purchases were immediately to be absorbed by higher labor costs.

Another illustration of changes in finishing departments is found in automobile factories. Certain parts, such as fenders, are enameled by being dipped. At one end of a very long, slow-moving conveyor, the parts to be finished are hung on the conveyor by a single employe. They slowly move into and through a tank of enamel, passing rom this over troughs into which the excess enamel drips. They then pass through an oven for baking. This process is repeated twice more, after which the parts are detached from the conveyor by an employe stationed at the discharge end. A process of this kind, used wherever practicable, reduces the payroll to a point much below that required for finishing either by the hand brush or spray method. Now the finishing department in the automobile factory represents a low hazard department; consequently payroll reductions in this department tend to cause an increase in the loss cost per unit of the plant payroll.

Another case is in the textile industry where the knot tying

machine, essentially non-hazardous, is able to do the work of several employes engaged in a non-hazardous manual operation.

In the printing industries, the linotype and monotype machines, although far from being recent developments, are constantly being introduced into plants which have previously used hand composition.

These machines are not only more hazardous, per man engaged, than hand composition but each machine is capable of doing the work of several hand compositors. Furthermore, since hand composition is less hazardous than the operation of printing presses, the introduction of machine composition tends not only to reduce the payroll but to increase the hazard as well.

In the brick industry, the introduction of the continuous, oil fired kiln replaces the payroll previously engaged in piling bricks in the older style temporary kiln. In this case, there is some doubt as to the relative hazard per man as between making the bricks and piling them in the kilns although it is believed that the manufacturing operations are more hazardous. If that is the case, then the effect of the introduction of the continuous kiln would be to increase the average hazard of the plant as a whole.

In the cigar industry, cigar making machines are constantly replacing hand labor. The modern shoe repair shop using machinery to a considerable extent, is replacing the older hand operation.

In some industries changes very materially reducing the accident cost have been made. A notable example is in the steel industry where, in addition to other important changes, the hazardous transfer and transportation of hot metals by man power was replaced by comparatively non-hazardous mechanical methods.

There are many other outstanding cases where the general direction in which labor saving might affect loss ratios can be determined by observation. There are innumerable cases where the approximate effect can be determined only by statistical investigation. Such an investigation might properly be undertaken from more than one viewpoint. From the humanitarian viewpoint, it is highly desirable to ascertain whether the substitution of machines for men tends generally to produce a greater hazard to the employe, and if so, the extent to which this may be or is being neutralized by safety engineering. From the rate

making viewpoint, this is likewise important but quite as important is the effect on loss ratios produced by the changes in payroll incidental to such substitution.

In any event, the investigation should be made by industries. From the rate making point of view, it might advantageously take the form of a comparison of accident costs over a series of years as between mechanical and non-mechanical accidents. In using accident cost figures, it would of course, be necessary to make suitable modifications to discount changes in the compensation law and changes due to the general upward trend of medical costs. There are, to be sure, elements listed in the early part of this paper, bearing on the increase in cost per accident and in the increase of accident frequency, other than law changes and medical cost changes, and other than the element of change from hand labor to mechanical labor, but these appear not statistically measurable and would in any event, apply to all classes of accidents in about the same degree.

From the non-ratemaking point of view, the investigation should present a comparison by industries of mechanical and non-mechanical accidents, suitably weighted to measure severity with the employe now as the unit of exposure.

Such investigations should indicate which industries are becoming more hazardous, whether measured in terms per unit of payroll or in terms per unit of employe exposure. They would not however, bring out every case of increased cost due to labor saving for there are cases where there should be no material change in the ratio of mechanical to non-mechanical accidents. One of these is the change from hand to spray painting. Neither of these processes would contribute an appreciable number of accidents which would be classified as due to mechanical causes. The principal effect of this change would be to decrease the number of employes exposed to comparatively low hazard. The investigations might perhaps with advantage, undertake to measure the hazard trend in terms of units of production. This would involve determination of the average number of units of production per unit of payroll or per unit of employe exposure and would be the most feasible in case of industries of the so-called "basic" type, such as brick making, steel making, cloth spinning and weaving and the like, where the product has not been materially changed during the period under investigation:

thus eliminating all questions and complications due to changes in product, as in furniture manufacturing, or to variety of product, rendering the choice of a suitable unit of production impossible. This investigation would be interesting as showing whether, even though it should appear that industry was becoming more hazardous to the individual employe, it might not still effect the same volume of production with a diminished human wastage.

It would also, from the rate making point of view, be interesting to collect figures showing whether the proportion of compensation cost per dollar of value of the finished product, is becoming greater or less.

Finally, some consideration should be given to the question whether the present trend towards mechanization of industry will be maintained. This involves several considerations.

1. The necessity for effecting economies in labor cost depends upon the available supply of labor and the rate of wages, and secondarily therefore, upon such general economic and social questions as immigration, natural increase of population, the labor movement, the shift of population to the cities and the like.

2. The possibility of continuing the present program is also to be considered. It is probable that the peak of the movement has not been reached, and that it will not be reached during the life of the present generation, although there is undoubtedly a point beyond which the human element cannot profitably be replaced by machinery.

Mr. Edward A. Filene of Boston, is quoted in an article on immigration appearing in the September 26, 1925 issue of the *Saturday Evening Post* as saying:

"Employers do not need an increased labor supply, since increased use of labor saving machinery and elimination of waste in production and distribution will, for many years, reduce costs more rapidly than wage increase."

This appears to be a logical point of view since there is little reason to believe that the human race will not be as mechanically ingenious in the future as in the past.

TABLE I

Showing the Ratio of Horse Power to Man Power in certain industries at different times as indicated by the United States Bureau of the Census Reports

Industry	1889			1899			1904			1909			1914			1919		
	Primary Horse Power	Wage Earners	Ratio	Primary Horse Power	Wage Earners	Ratio	Primary Horse Power	Wage Earners	Ratio	Primary Horse Power	Wage Earners	Ratio	Primary Horse Power	Wage Earners	Ratio	Primary Horse Power	Wage Earners	Ra
ıral Implements	30,395	38,857	1.3	70,646	46,588	1.5	89,738	47,394	1.9	100,601	50,551	2.0	121,428	48,459	2.5	128,249	54,368	1
ın & Fire Arms		2,158		2,980	5,231	.6	5,056	7,410	.7	10,317	8,713	1.2	11,354	11,493	1.0	39,128	22,816	1
ronze etc.	27,571	21,849	1.3	47,257	27,166	1.7	69,494	33,168	2.1	106,120	40,618	2.6	122,700	40,306	3.0	265,688	75,051	2
ıeese, Condensed Milk	25,586	18,219	1.1	88,062	12,799	6.9	93,845	15,557	6.0	101,349	18,431	5.5	130,862	23,059	5.7	169,871	35,313	4
	1,680	3,821	.4	4,165	8,685	.5	6,982	10,567	.7	12,831	16,427	.8	14,398	14,511	1.0	16,201	15,577	1
ı Preserving	7,000	61,812	.1	38,624	57,012	.7	60,831	56,944	1.1	81,179	59,968	1.4	120,004	74,071	1.6	180,812	89,923	1
s, Wagons & Materials				83,771	73,812	1.1	106,159	77,882	1.4	126,032	69,928	1.8	112,549	52,391	2.1	64,666	24,682	2
ı Pipe										18,737	12,228	1.5	25,864	12,557	2.1	28,741	12,625	2
s & Allied Prod.					15,163		132,394	19,847	6.7	208,657	23,729	8.8	282,385	32,311	8.7	376,940	55,586	6
e & Cocoa Prod. &																		
ɔnery & Ice Cream				2,756	1,314	2.1	7,204	2,090	3.4	10,593	2,826	3.7	19,736	4,160	4.7	33,440	9,083	3
ı.& Allied Indus.	121,821	123,154	1.1	252,502	105,693	2.4	360,280	118,449	3.0	451,186	132,696	3.4	465,152	126,887	3.7	434,836	104,849	4
Preparations	3,439	10,485	.3	12,707	19,028	.7	17,008	20,472	.8	25,659	22,895	1.1	28,872	25,502	1.1	40,571	38,417	1
ɔh. App. & Supp.	7,494	8,802	.9	43,674	42,013	1.0	105,376	60,466	1.7	158,768	87,256	1.8	227,731	118,078	1.9	438,839	212,374	2
Locomotives & Aircraft													63,047	29,657	2.1	190,021	77,617	2
ll & Grist Mill Prod.				670,719	32,226	20.8	775,318	39,110	19.8	853,584	39,453	21.6	822,384	39,718	20.7	876,405	45,481	19
roducts	165,875	536,937	2.2	1656,594	508,766	3.3	1886,624	532,566	3.5	2840,082	695,019	4.1	2734,014	614,548	4.4	2922,656	610,246	4
ıre of Glass	28,241	44,892	.6	52,943	52,818	1.0	91,476	63,969	1.4	123,132	68,911	1.8	163,139	74,502	2.2	207,430	77,520	2
& Starch							35,986	4,679	7.7	28,257	4,773	5.9	41,639	4,509	9.2	52,846	7,795	6
Steel				1598,073	222,490	7.2	2422,577	242,640	10.0	3274,400	278,505	11.8	3928,826	278,072	14.1	5420,349	416,748	12
Industry	60,031	42,392	1.4	88,860	52,109	1.7	117,450	57,239	2.1	148,140	62,202	2.4	172,712	55,936	3.1	218,238	72,476	3
y, Textile Machinery & Mach. Tools																41,997	31,823	1
ıred Ice				100,421	6,880	14.6	191,660	10,101	19.0	317,789	16,114	19.7	461,988	23,011	20.1	572,970	30,247	18
Instruments	11,788	18,096	.7	23,288	24,981	.9	34,259	38,617	.9	49,417	45,041	1.1	57,902	48,768	1.2	91,258	68,741	1
les & Bicycles & Parts				19,847	17,525	1.1	5,750	3,319	1.7	5,932	4,437	1.3	8,753	6,680	1.3	14,806	10,886	1
Pins & Hooks & Eyes	1,183	1,827	.6	2,103	2,653	.8	2,440	3,965	.6	4,542	4,628	1.0	4,813	5,330	.9	8,467	9,894	
ı & Linoleum				7,561	3,230	2.3	10,112	3,883	2.6	16,125	5,201	3.1	22,272	5,651	3.9	28,010	6,544	4
ı Refining	32,536	11,403	2.9	36,127	12,199	3.0	46,019	16,770	2.7	90,268	13,929	6.5	128,468	25,366	5.1	238,906	58,889	4
ındries & Dyeing & Cleaning										123,477	109,484	1.1	174,881	130,641	1.3	196,793	131,879	1
ıning & Polishing				7,546	651	11.6	15,866	1,492	10.6	19,519	1,239	15.8	15,571	1,253	12.4	27,382	2,113	13
ıdustry	27,125	20,152	1.3	71,169	36,565	1.9	86,808	43,873	2.0	122,436	49,264	2.5	199,543	74,022	2.7	429,887	158,549	2
lding							78,187	50,754	1.5	88,063	40,506	2.2	115,333	44,489	2.6	553,711	387,446	1
ing & Meat Packing				85,008	68,386	1.2	115,956	74,134	1.6	202,432	87,813	2.3	253,066	98,832	2.6	359,212	160,996	2
& Refining				95,740	24,512	3.9	141,928	26,853	5.3	206,537	29,707	7.0	261,419	34,733	7.5	447,779	37,579	11
ıstry							20,228	11,044	1.8	28,360	12,999	2.2	35,737	14,172	2.5	33,710	20,436	1
Electric Cars				55,395	33,453	1.0	55,994	34,058	1.6	97,797	43,086	2.3	126,687	54,288	2.3	157,865	52,298	3