

BUSINESS FAILURE IN THE EARLY AUTOMOBILE INDUSTRY, 1895-1910

Professor J. R. T. Hughes at last year's meeting of this Association delivered a paper on the entrepreneur and American history.¹ In the course of his delivery Professor Hughes suggested that business failures might have important implications for economic growth. Quoting Hughes admittedly out of context:

In the long pull of the nation's life many financial failures had important effects ... failures can be important information about the directions ... of growth.²

While these comments were meant as guides to the economic historian, business failures also provide much useful information to surviving firms as to the directions of industry growth.

A cursory glance behind the usual statistical series that reflect the fabulous expansion of the automobile industry during the first decades of the twentieth century reveals a staggering number of business failures over the same period.³ The automobile industry for instance in 1899 produced 3,200 automobiles and in terms of value of product ranked 150th among the industries of the economy. So rapid was the subsequent growth of this industry that 20 years later it manufactured over 1,600,000 automobiles and ranked second among all industries in terms of value of product.

During this same period over 775 automobile firms entered the industry, and over 77 per cent of these (around 600) retired.⁴ The expected life span of automobile firms in a sample taken from Ralph C. Epstein's early study of the industry suggests an average life expectancy of less than 6 years.⁵ This estimate is for several reasons probably optimistic; the true value probably lies closer to 3 years but is cited to suggest the existence of a rapid turnover among automobile manufacturers.⁶

The argument presented in this paper is that these numerous failures were not just a costly consequence of the rapid growth of the automobile industry, but that they actually served to accelerate the rate of expansion of the industry. The essence of this seemingly twisted argument is that business failures provided for surviving firms information of particularly vital importance about the nature of the existing demand for motor cars. In a market environment characterized by extreme uncertainty such

as the early automobile industry, the information provided through the failure or serious reverses of rival enterprises often meant the difference between future profits and losses for surviving firms.

Each automobile manufacturer has always encountered a continual problem of how to acquire information about existing consumer desires about product characteristics and how to keep this information current. Modern techniques of market research either were not available to the industry during its infant years or were prohibitively expensive, thus forcing manufacturers to seek market information where they could find it. A major source of readily available market information was the current and past performance, both good and bad, of rival firms.⁷

Given that a large number of automobile manufacturers existed within the early automobile industry, the existence of significant differences between firms was almost a certainty as, of course, were differential degrees of success. Those elements which successful firms held in common in a market environment like the fledgling automobile industry were naturally associated with success and widely imitated; and conversely those elements associated with unsuccessful firms were associated with failure under the current market conditions and studiously avoided.⁸ Business failure or serious reverses thus contributed to the existing information about the current state of the market, enabling surviving firms to modify their behavior to conform with existing market requirements.

While both success and failure among motor vehicle manufacturers provided important information about the nature of the automobile market, this paper will concentrate upon the role of failures. Financial failures during the pioneer era played an important role in the settling upon the gasoline engine as the standard source of power and the subsequent adoption by the industry of the "French" style as the basic design. Business failures in the subsequent period also seem to have been instrumental in the adoption of new institutional arrangements which allowed the small producer to survive for another decade in competition with the new production methods adopted by the large manufacturer.

It will be argued below that the business failures provided essential information on the basis of which surviving firms could adjust to new market conditions as they evolved. Financial failures thus accelerated the pace with which the industry discovered

its market and in that way contributed to the rate of expansion of the automobile industry.

I

During the year 1895 there appeared distinct signs that the automobile in America was, after almost a century of experimentation, about to come of age much as it already had in Europe. The U. S. Patent Office during 1895 received over 500 applications for patents on motor vehicles. That year the first firm to produce gasoline-powered automobiles, the Duryea Motor Wagon Company, was organized; firms attempting to produce steam— and electric-powered vehicles were already in existence.⁹ A trade journal, called *Horseless Age*, made its appearance during that year to service the fledgling industry which, at that time, consisted of less than a half dozen small firms.¹⁰ *Horseless Age* circulated among the numerous experimenters, many of whom were attempting to develop a motor vehicle which could be put into production.

It appears that firms such as the Duryea Motor Wagon Company were born too soon, for they sold few automobiles before 1898. The main reason seems to have been general lack of a workable motor vehicle, and the next three years were subsequently spent developing such a machine. The depressed economic climate of that era hindered experimenters' efforts by rationing the supply of capital available for development purposes. The fledgling industry, however, seems to have overcome this problem by 1898, having succeeded in spite of the shortage of capital in developing a vehicle with commercial possibilities.

As soon as experimenters had developed a fairly reliable vehicle, capital to put it into production seems to have become readily available. The electric vehicle reached the stage of workable reliability first. In fact, it was not significantly improved thereafter. The motor was smooth, simple, reliable, and light weight compared to gasoline or steam power. However, its range was limited and construction was made very heavy due to the large, fragile battery which it was forced to carry. This was not at this time a serious handicap, for the public was pleased by anything that ran without horses with any semblance of reliability.

The Pope Manufacturing Company, then the largest producer of bicycles in America, entered the industry with the Columbia Electric on Thursday, May 13, 1897.¹¹ The Columbia

sold for \$3,000. Morris and Salom, a Philadelphia firm, began building electric vehicles during the same years after having built a prototype for the 1895 Times Herald race. The Riker Electric Motor Company was organized in 1898 in Brooklyn after its prototype won the Rhode Island Fair race.¹² The first commercial producers of motor vehicles seem generally to have chosen electricity as the source of power.

The occasion of the first motor vehicle exhibition in the United States, held in Boston during October 1898, listed forty manufacturers and/or experimenters about to enter into manufacturing.¹³ Twenty-seven of the exhibitors showed gasoline-powered vehicles; eight were electric powered; three were respectively steam powered, carbonic-acid powered, and compressed-air powered.

The Duryea, Haynes-Apperson, and Winton alone among the gasoline-powered vehicles were actually in production at the time of the exhibition. While there were more gasoline vehicles exhibited than other types, more producers of electric vehicles were actually in production, and the manufacturers of electric vehicles were without exception larger than their rivals. Electric-vehicle producers such as Riker, Columbia (Pope), Waverly, and Woods (Fisher) were in quantity production. The steam producers were neither large individually nor in numbers; Whitney and Stanley alone were in production. Neither the carbonic-acid nor the compressed-air vehicles ever got into commercial production.

The electric vehicle early caught the attentions of the engineers within the industry and they convinced the financiers that the future of the automobile was with electricity. Contrast, for example, the merger between the Indiana Bicycle Company and the American Electric Vehicle Company, to produce the Waverly electric vehicle, with the formation of the Haynes-Apperson Motor Car Company both in 1898. The Waverly plant was to employ 1,000 men and produce 4,000 vehicles a year; the Haynes-Apperson firm had a total capitalization of \$25,000 and was to produce one vehicle a week.¹⁴

Another example of the electric's ability to attract capital is found in the formation of the Woods Motor Vehicle Company. The president of Woods was none other than Samuel Insull, and the officers of the company listed the presidents of the Canadian General Electric Company, Northwestern Telegraph Association of Canada, and the Northern Trust Company. Woods

was to have two factories in Chicago and a single plant each in Cincinnati, New York, and San Francisco. One of the Chicago plants was to employ 600 men. The capitalization of the firm was to be \$10,000,000, a staggering amount for the times.¹⁵

That at this time the electric vehicle was the most promising vehicle about which to build an industry is pointed out by the attempts of certain financiers to monopolize the production of electric vehicles.¹⁶ Certainly these men must have obtained professional advice before embarking upon such a venture. The Lead Cab Trust serves to illustrate a further point about the fledgling automobile industry. The persons involved in this attempt at monopoly believed the future of the automobile was in its commercial applications: taxis, buses, light delivery wagons, etc. This idea of the market for motor vehicles was shared by much of the automobile industry around the turn of the century.

It was widely believed that to successfully compete in the market for commercial vehicles, the motor vehicle had to be competitive with a horse and wagon in initial cost. This required a low-cost vehicle, and the electric fit the bill. These vehicles were generally assembled out of available parts, the manufacturer purchasing the chassis from a carriage maker, the engine from an engine maker, etc., modifying each part to suit his purposes.

It was such a production process that a well-known English engineer, Alf R. Sennett, had earlier advocated.¹⁷ His idea was that since there existed carriages, motors, belts, chains, and gears — *ergo* we have motor vehicles. This was one of the first published expressions of the idea of assembling motor cars rather than manufacturing them. Such a process had much to recommend it to the embryonic motor vehicle producer: it required little capital, less engineering time, and it was less expensive to buy existing components than to manufacture them. Thus the manufacturer could get into production quickly with a relatively inexpensive product for the commercial vehicle market.

Manufacturers as a direct result of holding the idea that the existing market for motor vehicles was for a commercial vehicle, were forced to offer a design to meet these demands. The resulting design was makeshift, the available components setting the design of the vehicle rather than the other way about.

While the larger firms in the industry at the turn of the century preferred electric power and believed their major market to be in commercial vehicles, there were lesser firms which believed otherwise. These firms, largely located in the Midwest, chose gas-

oline as the source of power and did not concentrate upon the commercial car market but instead chose to produce automobiles for the sportsman and later for the social set. These vehicles were designed for personal, not commercial, use and fashion played a key role in determining the demand for this type of automobile.

Generally, in contrast to electric vehicles, gasoline vehicles were handcrafted in the plant of the manufacturer. The various components were machined in the plant from designs created by the firm's chief engineer, who often was the owner of the firm. The materials were those specified by the engineer, and the assembly of the various components was directly supervised by the manufacturer. The result was a workable motor vehicle capable of performing quite well relative to steam and electric vehicles of the day but which was also generally more expensive.

There appears from the foregoing that there was a considerable division of opinion about the nature of the demand for motor vehicles. Men of means on the one side favored the electric-powered taxi or light delivery wagon and on the other side several smaller firms concentrated upon passenger vehicles for the sportsman. Steam producers, it seems, were in the main undecided and produced both types of vehicles as did, of course, most electric and gasoline manufacturers; none, after all, was at this time certain about the true nature or the demand for automobiles.

This uncertainty over the nature of the initial demand for motor vehicles was resolved in time as both types of vehicles were offered in the market. The electric commercial vehicle failed dismally in its attempt to supersede "Old Dobbin" and in the process brought down several of the larger automobile firms. Professor Rae has pointed out the problems the Electric Vehicle Company faced about this time.¹⁸ In the meanwhile, the gasoline-powered personal passenger vehicle was relatively well received. Almost overnight the commercial vehicle was abandoned by the industry. Electric power was also associated with failure and also widely abandoned as a source of power. The gasoline engine thereafter enjoyed new popularity among automobile producers and the passenger car market became, for a number of years, the sole concern of the automobile manufacturer.¹⁹

II

FIRMS within the automobile industry had discovered at the turn of the century, as a direct result of a lack of success in any other areas, that the existing demand for motor cars was for a personal passenger vehicle. Identification of this market seemed to focus the attentions of automobile manufacturers upon the problem of obtaining information about the nature of the demand within this market. The lack of commercial success on the part of producers of steam and electric vehicles at the turn of the century had convinced most automobile manufacturers that the gasoline engine was the proper source of power. These manufacturers had not, however, reached any degree of consensus as to a standard design for a gasoline vehicle.

Initially, with little to guide them, automobile manufacturers offered a motor vehicle which was essentially a horseless carriage — a buggy with a small engine mounted amidship. Gasoline vehicles of this type offered sufficient performance and reliability to interest the wealthy urban sportsman. However, between 1900 and 1905 on the average over 40 new firms entered the industry annually, offering new models to the market.²⁰ This large annual immigration into the automobile industry totaled 267 new firms during this brief span of time. It was inevitable that out of so many new and different designs some would be more successful than others.

The market was offered vehicles of almost every description, from the little and very successful Curved-Dash Oldsmobile to the not-so-successful Adams-Farwall, with its radial engine located above the rear axle, or the equally unsuccessful Owens-Magnetic with its magnetic automatic transmission.²¹ Currently popular designs changed often early in the century, and it was not unusual for a firm to introduce several designs during one year. Those manufacturers which produced prototypes for the annual automobile shows often developed several models and decided *ex post facto* to produce the ones that proved the most popular at the show. The following quotation illustrates the high degree of uncertainty as felt by the pioneer motor car producer as to the correct current design:

Back in the early days when we went to motor shows, it was the custom of manufacturers to arrive with their engineers and perhaps a casual shop man or two. If they had prepared a new car blueprint in advance they exhibited and took orders for cars as per print. In some

instances in the very early period they even waited until they arrived at the show before drawing the picture of the model they thought they would produce the next year.²²

The industry between 1900 and 1905 developed literally hundreds of designs which were offered to the public. A manufacturer when introducing a new model could not be sure, even if it were initially successful, that within a few months it would not be obsolete and unsalable. The result was to generate a large degree of uncertainty among the firms in the industry about the future course of product design. The effect of this uncertainty was to severely hinder the development of the production processes which were required for the later rapid expansion of the industry. It is self-evident that few firms would commit the large amount of capital necessary to produce a design at low cost and in quantity, when it was probable that the design would soon become obsolete.

The automobile manufacturer, however, was not totally without information about current consumer preferences. The performance of rival firms relative to its own offered some guide. The negative examples set by firms that were forced to withdraw, and there were 132 of them between 1900 and 1905, often pointed out what not to do, as well as the positive examples of very successful firms indicating what design features it was profitable to offer.

The final evolution of a standard automobile design was hastened by a conscious policy on the part of automobile firms to avoid what they felt were the mistakes of recently departed firms. Financial failures thus served the purpose of indicating what not to do. On the other side of the coin, the examples set by successful firms indicated ways that with a high probability would lead to profits rather than losses. As *Horseless Age* pointed out:

Man is an imitative animal. If he sees one of his fellows making a success of something he immediately sets about imitating his example.²³

The design that was eventually accepted as the standard in the American automobile industry resulted from the direct imitation of imported automobiles.

The early demand for automobiles was very much influenced by the fashion motive and by the nature of many items of fashion; the domestic producer quickly discovered and favored

the imported French designs. These designs quickly captured the relatively large luxury car segment of the demand for automobiles which forced domestic producers of this type of vehicle either to change their design, if possible, or to be forced out of the market. The result was that those firms that could imitate the imported designs did so, and those that could not were eliminated through the competitive process.

Between 1903 and 1905 firms such as Packard, Peerless, Winton, Rambler, and others successfully introduced imitations of the imported machines. Locomobile, for example, abandoned steam power and introduced a large and expensive four-cylinder machine of the French type. Pierce-Arrow at the same time dropped the one-cylinder buggy design in favor of a design of the imported type. Other firms whose names are now of no consequence either failed in their attempt to imitate the new design or failed to try and were eliminated from the industry. The ultimate consequences of their failures were certainly not lost upon the rest of the industry. The folly of attempting to compete with a buggy design in the same price range with a good imitation of the imported designs was made clear to most automobile manufacturers by the reverses suffered by those that tried.

The rapid changeover to the new design was evident at the opening of the 1905 New York Auto Show. An observer of the show related that "... the most noticeable improvements of the 1905 types of automobiles are in the remarkably handsome bodies."²⁴ The observer went on to point out that gasoline vehicles "... constitute the great majority of automobiles in use at the present time, and it is in this class that the most notable improvements have been made." The use of vertical four-cylinder engines is found in "... almost all the large cars of whatever manufacturer." "The sliding gear transmission and bevel gear drive are by far the most prominent." Chain drives are found in only the lightest machines. Pressed steel frames are now in the majority, the wooden artillery wheel has replaced the wire spoke wheel, and the ignition is by spark.

An observer at the 1906 show remarked that the 1905 model year had "... been productive of conditions which in all probability will never be duplicated in the future."²⁵ He remarked that compared to the present automobiles the vehicles shown at the 1900 show were a "...very disheartening array of freaks in the light of present day advancement." The year 1905 was "... a period when for the first time manufacturers were in a position

to heave a sigh of relief and give some attention to matters other than solving the problem of how to make a car that would run and could be depended upon to do so." "Matters have gradually assumed a condition where radical or revolutionary changes are not merely highly improbable but next to impossible."

The automobile industry thus reduced the extreme uncertainty that existed in the industry by adopting a standard design. The uncertainty that surrounds the introduction of a new model exists to this day in the automobile industry, but after 1905 it was significantly reduced from what it had been, and the information provided by business failures played a key role in its reduction.

III

The standardization within the industry upon a basic design, in the process of somewhat easing the degree of design uncertainty, allowed manufacturers increasingly to concentrate upon improving the methods of producing automobiles. The newly adopted standard design was much more complex than the traditional "buggy" design, hence initially more costly to produce. Yet it was considered by consumers so superior to the previous automobiles that they were willing to pay a premium price to obtain the new design.

The average wholesale price of automobiles rose significantly with the industry changeover to the new design. The wholesale prices more than doubled between 1904 and 1908, rising from \$1,066 in 1904 to \$2,129 in 1908.²⁶ The fact that an increasing percentage of the sales of the industry was of the new more expensive designs is the major explanation for this large price increase.

The introduction and acceptance of the new design first occurred between 1904 and 1906 in the luxury price class where automobiles sold for over \$3,000. The success of the new designs in that class led to attempts to develop similar but lower cost versions. The easiest way to do this was to reduce the size and power of the automobile yet keeping the same basic design. As these versions of the standard design were progressively introduced at ever lower prices, the "buggy" designs were eliminated.

A reliable standard design was introduced to sell for around \$2,000 in 1907; in 1908 such a vehicle was introduced for a-

round \$1,500 and the next season a \$1,000 standard design became a reality when it was introduced simultaneously by Ford and Buick. Thus between 1906 and 1908 the standard design filtered down the price structure of the industry.

The reduction in the level of uncertainty surrounding the design of the automobile attracted during these years waves of new firms into the industry. As one writer on the automobile industry recorded:

No event, short of a gold rush, ever attracted so many people in so short a time into a new industrial endeavor as did the making of motor cars.²⁷

During 1906, for example, 50 new firms entered the industry, more than in any previous year except 1903. In 1907 and again in 1908 fully 92 new firms began to manufacture automobiles — nearly as many each year as in any two previous years combined. Many of these new firms were former carriage producers which had foreseen the imminent decline of that industry. The number of failures increased somewhat during this period: in 1906, 24 firms withdrew; in 1907, 59; and in 1908, 58 firms discontinued the production of automobiles. But the number of failures were insufficient to keep the number of firms producing automobiles from annually increasing. In 1905 there existed 157 firms in the industry, and by 1908 this figure had grown to 250.²⁸

It appears that little basic information was gained through the failures of this particular period except perhaps that it was more difficult to produce automobiles than carriages.²⁹ Even the offering of a standard design was not insurance in itself after 1905 of success within the automobile industry. For as another student of the industry has written:

Whatever the name plate, and however greatly the actors in the motor drama vary in personality or locale, the elements are the same. Variation in detail could mean success or failure, comedy or tragedy.....

Yet, the period between 1906 and 1908 was not one of dynamic changes; and the business failures that occurred carried no common warning. The period was one in which the standard design was successively adapted to ever lower price ranges. Those firms which resisted this change were eliminated, but that information was available at the beginning of the period.

IV

The automobile industry had throughout its brief history been expanding its output at an annual average rate of about 45 per cent. Annual variations in the rate of growth had of course occurred, corresponding roughly to changes in general business conditions, with the industry growing more slowly during recessions and more rapidly during good times. During the three-year period between 1908 and 1910 the rate of growth increased sharply as the industry tripled its output, the increase between 1908 and 1909 alone being about 100 per cent.

This remarkable expansion was triggered by the expansion of the \$1,000 class which, during the three-year period, increased its output almost 600 per cent. This class included cars selling for between \$875 and \$1,375 depending upon body style and equipment; its relative position rose from 19.5 per cent of the industry's output in 1908 to 39.4 per cent of total output in 1910.²⁹

Two firms — the Buick Motor Car Company and the Ford Motor Company — were mainly responsible for this expansion. During 1908, Buick and Ford introduced into the \$1,000 price class for the first time automobiles of the now standard French design. These designs, the Buick Model 10 and the Ford Model T, were similar to cars being sold in the \$1,500-\$2,000 price class except that where the more expensive cars had engines of 30 to 40 horsepower and a chassis with a wheelbase of around 116 inches, the new designs were less powerful and smaller than their more expensive rivals. The new Buicks and Fords were nevertheless recognizable as automobiles and for the price and times quite stylish.

The introduction of these two models had important effects upon the automobile market. As noted earlier, the \$1,000 price class had previously accounted for 19.3 per cent of the industry total; in this class honors for the most popular car had been shared by the Cadillac Model T, powered by a one-cylinder 10-horsepower engine in an 82 inch wheelbase chassis, and by the two-cylinder Maxwell.³⁰ The new Buick and Ford immediately made these models obsolete. Ford advertised that "no car under \$2,000 offers more, and no car over \$2,000 offers more except trimmings." Except for the Buick, Ford's claim came close to the truth. These automobiles, designed to sell for around \$1,000, were better cars in almost every way than the \$3,000 car of 1905.³¹

The market responded dramatically; Buick and Ford found that their sales were limited only by their capacity to produce. Buick, which in 1908 had sold 8,500 cars, saw its output increased during the next season to 18,500 units; and Ford increased its output from 6,200 units to 10,500. Buick during the year earned a profit of several million dollars and Ford made over \$3 million. Such success was swiftly imitated during the next season by Willys-Overland, Maxwell, Reo, and Hupp, which introduced competing models priced to sell for around \$1,000.

The new \$1,000 automobile offered essentially similar features to those found in the medium-priced automobile which cost \$500 to \$1,000 more. In fact, consumers did not think the minor differences worth the added cost, and many producers of medium-priced vehicles suddenly found themselves without a market.

The high- and luxury-price classes at this time were not immune to this shift in the preferences of consumers toward the improved, less-expensive automobiles. The high-priced and luxury classes in 1909 had produced a record total of 30,000 cars.³² This market became saturated in 1910 when only 18,000 units were sold. Between 1910 and 1914, the annual market for these expensive vehicles did not change substantially but hovered around 17,000 to 18,000 units.³³ While the output of most of the industry was expanding rapidly, the high-price class was stagnating.

This sudden reallocation of the automobile market was a catastrophe for the small producers. A total of 83 manufacturing firms, or 44 per cent of all the firms in the industry, failed during 1909. The majority of these firms were small assemblers of medium-priced automobiles, many of whom were former carriage manufacturers which had only recently entered the industry. In 1910, 29 more firms failed most of which were small producers of luxury- and high-priced automobiles. Survival suddenly became a critical problem for the small automobile company.

The failure of such a large percentage of automobile firms in two years resulted in the failure of several parts and components suppliers which had advanced them credit.³⁴ The automobile industry was not so interdependent that these failures of parts suppliers in turn (by disrupting the supply of a vital part) could cause the failure of other automobile manufacturers, etc.

Small automobile manufacturers were generally, as of this time, primarily assemblers of parts produced to their specifications by parts suppliers. Such manufacturers now faced the crucial fact that if they were to survive they must lower the cost of these parts. Small-scale assembly was still no disadvantage, but high costs of parts were suddenly of critical concern. The specter of so many small firms simultaneously failing stirred similarly sized surviving firms into action.

These small producers of medium- and high-priced cars were almost members of the Association of Licensed Automobile Manufacturers (A. L. A. M.), which could boast 90 per cent of all automobile firms as members, but whose members did not produce 50 per cent of the output of the industry. The first step these producers took was to set up outside their manufacturers' association a professional association with an extensive program to achieve inter-company technical standards.³⁵ The ultimate aim of both groups was to develop interchangeable parts between companies.

Because of the nature of the economic crisis within the industry, the vast majority of members in the resulting Society of Automobile Engineers were from the small independent firms. Of the 109 members of the standards committee, only three were from General Motors, and none were from Ford, Studebaker, Willy-Overland, or Reo. Yet these five firms represented 49 per cent of the industry output in 1910. The reason for the lack of interest on the part of the largest producers is obvious; they were large enough to take the entire output of their parts suppliers. In effect, they had their own inter-company standards. Ford early led the way in this direction, and General Motors undertook an extensive interdivisional standards program in 1911. The large producers had little to gain from the S. A. E. program and less interest in enabling the small producers to survive.

Howard E. Coffin, of the Hudson Motor Car Company, was elected to head the standards program for the S. A. E.³⁶ Hudson, whose output in 1910 was 5,000 automobiles, was the largest firm actively interested in establishing intercompany technical standards. According to Coffin, only intercompany standards could provide the assembler with alternative sources of supply. Lack of standards was "responsible for nine-tenths of the production troubles and most of the needless expense in the manufacture of motor cars."³⁷ For the parts producers as well,

intercompany standards would be an advantage, enabling them to specialize and thereby to reap the economics of large-production runs, and to produce for stock, which would allow faster deliveries, higher quality, and lower prices.

This program, despite the opposition of the larger firms and of some parts suppliers, met with great success.³⁸ Two examples of the reduction in waste achieved are the selection of 35 lock washers, out of more than 300 previously used, and the reduction in the varieties of steel used from 1,100 to 150. The establishment of a standard range of sizes for tires, rims, spark plugs, wheels, and lighting equipment reduced the cost of these items and made it easier for dealers to stock replacement parts. Generator mountings and carburetor flanges were standardized, allowing interchangeability between various makes. Perhaps most important of all, screw threads and sizes, as well as nuts and bolts, were standardized. As examples of the cost savings of this program, the cost of ballbearings was reduced approximately 30 per cent and steel costs 20 per cent.

A second development occurred among parts and components suppliers. These firms around 1905, as soon as the standard design had more or less evolved, began to produce units of their own design or standard components.³⁹ Thus, firms such as Timkin, Weston-Mott, and Salisbury all produced axles from their own blueprints; Continental, Northway, and others offered manufacturers standard engines of various sizes. Radiators, transmissions, frames, steering assemblies, starting and lighting systems, etc., were now offered to the automobile assembler from the parts supplier's catalogs. The main disadvantage was that these parts were offered without alteration, the assembler had to make do with what he could buy.⁴⁰

This process allowed the parts supplier also to reap the economies of larger production runs and to pass on these savings via reduced prices to the assemblers. Thus, parts suppliers were able to take advantage of the available economies of scale. The savings involved, for example, in producing 7,500 units of one rear axle instead of 750 each of 10 different designs were enormous. The introduction of the \$1,000 car made the full utilization of this development in the parts and component industry necessary if the independent producers of medium-price cars were to survive.⁴¹

The sudden failure of numerous medium-priced automobile firms forced these producers to take steps to lower their costs of

production. The resulting standardization program significantly lowered the cost of parts and components to all producers. It was estimated that the standards program eventually saved automobile manufacturers \$750 million in 1921, or 15 per cent of the retail value of all automobiles sold in that year.⁴² The immediate savings were obviously substantial.

Between 1908 and 1912, the structure of the automobile industry significantly changed. A wave of mergers and consolidations occurred during the first two years of this period, including the formation of General Motors and United States Motors, and the merger of Studebaker with E.M.F., as well as others. At the same time that these consolidations were being carried out, the industry was also undergoing a production revolution. To be efficiently employed, the new technology which had now been introduced required a larger output than was previously essential. The production of the average automobile firm, therefore, increased steadily throughout the period from 1,221 cars in 1908, to 3,481 in 1910, and to 6,246 in 1912.⁴³ These figures really reflect the inclusion of a few large producers — rather than a general increase in the size of firm.

The industry throughout this four-year period thus became more concentrated, as several firms, producers of the \$1,000 car, struggled to the front. By 1911, the largest four firms held 52 per cent of the market.⁴⁴ Yet a definite market still existed for the medium-priced automobile with unique styling and a wide range of body types. This market almost doubled in 1910 over the disastrous year 1909; 1911 was a setback, but 1912 equaled the 1910 record, and 1913 almost doubled the output of 1912. The standardization campaign of the S.A.E. and the standard components of parts suppliers allowed the small producer to offer more in its medium-priced vehicles than did the producer of the \$1,000 car — a situation which did not exist in 1908 or 1909.

The rise of giant firms within the automobile industry with the introduction of the standard automobile design into the \$1,000 price class, and the subsequent domination of the lowest price class by the Model T Ford, radically altered the structure of the industry. The general features of an automobile were set within the industry and producers of motor vehicles after 1910 were now concerned with increasing their production capacities.

This paper has attempted to point out the role played by business failures in accelerating the adoption of a standard de-

sign within the industry — a prerequisite for the later rapid growth of the industry. It is suggested that when viewed in this light, business failures made a positive contribution to economic growth. This function is by no means confined to the automobile industry. A casual investigation of other industries suggests that many had to discover through the process of trial and error the nature of their markets, and that in the radio, refrigerator, and home-television industries, business failures also provided useful information to surviving firms.

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FOOTNOTES

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- ² *Ibid.*, p. 214.
- ³ A. D. Chandler, Giant Enterprise (New York: Harcourt Brace, 1964), pp. 3-7.
- ⁴ R. P. Thomas, "Innovation and Survival in the American Automobile Industry" (Unpublished Ph. D. dissertation, Northwestern University, 1965), Appendix.
- ⁵ R. C. Epstein, The Automobile Industry (Chicago: A. W. Shaw, 1926), p. 347.
- ⁶ Thomas, *op. cit.*, Appendix.
- ⁷ A. A. Alchian, "Uncertainty, Evolution, and Economic Theory," Journal of Political Economy (1950), pp. 211-21.
- ⁸ *Ibid.*
- ⁹ John B. Rae, American Automobile Manufacturers, The First Forty Years (Philadelphia: Chilton Co., 1959), p. 25.
- ¹⁰ Horseless Age (New York: E. P. Ingerson), Vol. 1, No. 1, November, 1895.
- ¹¹ Horseless Age (April, 1897), p. 4.
- ¹² James Rood Doolittle, The Romance of the Automobile Industry (New York: Klebold Press, 1916), p. 26.
- ¹³ Horseless Age (October, 1898), p. 146.
- ¹⁴ *Ibid.*, (July, 1898), pp. 5-6.
- ¹⁵ *Ibid.*, (April, 1899), p. 12.
- ¹⁶ John B. Rae, "The Electric Vehicle Company: A Monopoly that Missed," Business History Review (December, 1955), pp. 298-311.
- ¹⁷ Horseless Age (December, 1896), p. 3.
- ¹⁸ Rae, *loc. cit.*, pp. 298-311.

- ¹⁹ *The commercial vehicle or truck did not become an important segment of the automobile industry until just before the outbreak of the First World War.*
- ²⁰ *Thomas, op. cit., Appendix.*
- ²¹ *Stanley K. Yost, The Great Old Cars... Where Are They Now? (Mendota, Illinois: Wayside Press, 1960), pp. 17-20 and pp. 169-174.*
- ²² *Eugene W. Lewis, Motor Memories (Detroit: Alfred Publishers, 1947), p. 26.*
- ²³ *Horseless Age (January, 1899), p. 6.*
- ²⁴ *R. R. Greene, "Some General Features of the 1905 Automobile," reprinted in Floyd Clymers, Historical Motor Scrapbook No. 8 (Los Angeles, Floyd Clymer, 1955), pp. 51-3.*
- ²⁵ *Richard Wright, "The 1906 Motor Car in the Light of the Past," reprinted in Floyd Clymers, Historical Motor Scrapbook No. 7 (Los Angeles: Floyd Clymer, 1954), pp. 56-7.*
- ²⁶ *Thomas, op. cit., Appendix.*
- ²⁷ *Lewis, op. cit., p. 9.*
- ²⁸ *Thomas, op. cit., Appendix*
- ²⁹ *Professor Hughes in the article from which the opening quotation was taken indicated that not all financial fortunes are important to the Economic Historian. It is also true that not all business failures provide important information for surviving firms. The failures of this period do not seem to provide important information about the state of the market for survivors*
- ³⁰ *The base price of the Cadillac was \$950, and the price of the Maxwell \$825.*
- ³¹ *Alan Nevins and Frank E. Hill, Ford: The Times, the Man, the Company (New York, Scribner's, 1954), p. 448.*
- ³² *Epstein, op. cit., p. 340.*
- ³³ *Ibid., p. 93-8*
- ³⁴ *George V. Thompson, "Intercompany Technical Standardization in the Early American Automobile Industry," The Journal of Economic History XIV, No. 1 (Winter, 1954), p. 5*

- 35 *The mechanical section of the A. L. A. M. had been attempting to promote intercompany standards for several years (1905-1909) but until the crisis of 1909-1910 had met with little success; hence the formation of the independent Society of Automobile Engineers.*
- 36 *Thompson, loc. cit., p. 5.*
- 37 *The Society of Automobile Engineers: 1910 Transactions (1910), pp. 125-26.*
- 38 *Thompson, loc. cit., p. 8.*
- 39 *Horseless Age, "Building a Car from Standard Parts," XXIV, No. 23 (December, 1904), pp. 643-44*
- 40 *Ibid., p. 643.*
- 41 *The producer of automobiles for the medium- or middle-price class, after the introduction of the \$1,000 car, had to offer more style and performance for the money than previously. In order to do this, it was necessary to reduce the costs of his components, so that he could put more money into details.*
- 42 *Herbert Chase, "Executives Should Foster Use of Standards," Automobile Industries, XLV (1921), pp. 1101 ff.*
- 43 *Thomas, op. cit., Appendix.*
- 44 *This trend continued throughout the period under consideration. The largest four firms controlled 43 per cent of the market in 1908, 51.9 per cent in 1911, and 60.6 per cent in 1913.*