Introduction

1. In his studies of the “pure” theory of economy, Josef Alois Schumpeter (1883–1950) made an essential contribution to the analysis of the fluctuations of the state of the economy by pointing out the importance of innovations implemented by enterprises as impulses for the ups and downs of the economy (*Business Cycles*). (In the notes, titles of publications are given in abbreviated form. For more detailed references, see the bibliography at the end of the book.)

2. The term *electrical industry* is defined as follows: *(a)* Technologically, the electrical industry is characterized by goods and services for the generation, production, transformation, distribution, and application of electrical energy. *(b)* Business units of enterprises are considered part of the electrical industry if the predominant part of their activities involves the goods and services listed under *(a)*. See Sawall, “Unternehmenskonzentration,” p. 11.

3. In his memoirs Werner von Siemens equates the founding of the Electrotechnical Society in Germany in 1879 with the identification of the initial activities of electrical engineering as a special branch of technology. The term *electrotechnical*, describing technical applications of the science of electricity, was used for the first time in German in the name of that association. Werner von Siemens, *Lebenserinnerungen* (Memoirs), p. 280.

4. Ten years earlier Faraday had laid the foundations for the development of electric motors with the construction of his “rotary device.” Volta called the galvanic element an electromotor. This term was widely used for years and explains the term *electromotive force*. See Dettmar, *Entwicklung*, p. 12.

5. Shortly after Michael Faraday had established the law of induction, the Frenchman Antoine Hippolyte Pixii built a small genera-
tor for electricity using a simple horseshoe-shaped magnet made of steel revolving around a horseshoe-shaped electromagnet. Even though this first machine was of no particular practical use, it initiated a series of experiments with electromagnetic machines, instruments, and motors.

6. Manufacturing in preindustrial times was characterized by an intracompany system of production and by the predominant use of manual work. At the time Siemens went into business, factories had already combined production in large work units, unlike the so-called cottage industry; however, in contrast to the factories that were established later, such work units were not yet mechanized. Until 1867, when electric power engineering started to fundamentally revolutionize the structure of production, the Telegraph System Construction Enterprise Siemens & Halske differed from the traditional manual trade shop as well as from those who contracted out and from cottage industry in the following respects: by its use of capital accounting; by the formally free and contractually regulated character of the manual work performed in its facilities; by its separation of the workplace from the workers’ residences; by its size; and by the increasing centralization of the work processes. On the other hand, the company could not be called a fully developed factory, since the dominant form of production was still the cooperation of adjacent shops producing the same or similar devices. Like specialization in the manufacturing of specific products—a practice that gradually took hold as new branches of production were opened up—specialization with respect to the steps of production grew very slowly. In contrast to the majority of engineering shops in Prussia, until 1870 the machinery at Siemens & Halske consisted almost exclusively of nonspecialized machines. In 1863, for the first time, a steam engine was installed. See Kocka, Angestellten, pp. 24ff.

7. In 1888 hereditary nobility was bestowed on Werner Siemens. For purposes of uniformity, he is called Werner von Siemens throughout this book.

8. See Ehrenberg, Unternehmungen; Matschoß, Werner Siemens; Weiher, Werner von Siemens.


10. Although Werner von Siemens, because of his knowledge and his distinguished position in the government Telegraph Commission, had good prospects of becoming the director of the Prussian State Telegraph Service, he preferred to be an independent businessman, as
he stated in a letter to his brother Wilhelm, dated January 3, 1847: “... the tempting prospect, to rise to the position of director of the future Prussian Telegraph Service due to my outstanding role in the Telegraph Commission. I turned this offer down, since employment in civil service is not to my taste and I am convinced that I can do more for the world and myself if I secure absolute independence for myself” (Siemens Archives Files [SAA] WP Briefe [Letters]).

11. See Werner von Siemens, *Lebenserinnerungen*, p. 29. From the outset, Werner von Siemens expressly stipulated that the firm should concentrate primarily on manufacturing, not on activities as a contractor. He mentioned the reasons that led him to adopt this business principle in a letter to his brother Wilhelm, November 11, 1876: “Supplying goods forms a sure ground for continuing business, whereas contractor work is only profitable if the conditions are particularly favorable. An exclusive engagement as a contractor... flourishes only temporarily. A company engaged in producing and selling goods may outlast many generations, and that is more to my taste” (SAA WP Briefe).

13. SAA WP Briefe.
15. The perspectives that were behind such a management strategy are evident in a letter written by Werner von Siemens on May 13, 1863, to his brother Wilhelm: “As we are not able to perform foreign and distant investments profitably from here (Berlin), we had to establish firms in Russia, England, and Vienna, which can do business and make profitable use of our activities here with the help of our advance in telegraphy, supported by our manufacturing and capital as well as by our personal engagement here in Berlin, if necessary” (SAA WP Briefe).

16. Werner von Siemens clearly stated his objections in writing his memoirs in a letter to his daughter Anna, July 22, 1892: “For me the most important aspect is less the stylistic correctness of my notes, but that the plain truth about my feelings and thinking is reflected. I must be able to recognize myself in all parts, otherwise the whole thing will appear alien to me. Besides, I consider it to be a typical German mistake that our way of writing differs from our way of speaking. People should clearly recognize the individuality behind both one’s writing and speaking” (SAA WP Briefe).
17. SAA WP Briefe.

18. The analyses by Kocka and Conrad on internal business structures are particularly good. Extensive studies on enterprises abroad before 1880 are few, however. Important information is given in the master’s thesis by Jost Schmidt, Bonn, Germany, to which I had access by courtesy of the author. Apart from these, one must fall back on older literature, which does not always satisfy stringent academic criteria.

19. For this assessment see, above all, Kocka, Unternehmensverwaltung, p. 53. See also Werner’s letter to Wilhelm, July 7, 1866: “If the Germans should succeed in rising to the high level of the present situation and support the formation of a unified and strong Germany with Prussia at the top, instead of crying for their expelled princes or those trembling with fear anticipating such a fate, our children will obtain a real Fatherland and bless Bismarck and the Prussian Army.” A similar overtone can be detected in a letter to Wilhelm, September 25, 1866: “I am deeply convinced now that Bismarck is moved by the sacred spirit of a grand national mission, that he is resolved not to create a half-baked Germany but a whole and integral nation. This is the reason why I have detached myself from most of my former political friends and have campaigned and voted for the vote of confidence in his foreign policy” (SAA WP Briefe).

Chapter 1


2. The first stage of development of the telegraph industry in particular was characterized by enterprises that, in addition to their customary activities, adjusted to the requirements of governmental or private telegraphy. These primarily handwork-oriented firms, in the course of registration of “commercial conditions,” were first classified as part of the category “Mechanical artisans and craftsmen” within the subgroup “Mechanics for mathematical, optical, physical and surgical instruments.” Wessel, Entwicklung, pp. 141ff.

3. For 1890 a detailed list of production exists, published by the Central Association of the Electrical Industry (in million marks):
Electric motors and generators  5.5
Transformers  0.5
Storage batteries and other batteries  4.5
Switchgear and equipment  0.3
Equipment and tools for installation  0.3
Cables and insulated wires  8.0
Electric tools  0.1
Household appliances  0.2
Chandeliers  0.2
Lamps  0.3
Equipment and devices for communication
via cables and overhead lines  3.6
Equipment for timing, signaling,
and safety instrumentation  0.2
Active and passive components  0.2
Measuring, testing, and controlling instruments  0.3
Electromedical instruments and equipment  0.3
Electrographite  1.5
Repair services  3.9

See Dynamik.

4. Peschke, Elektroindustrie, p. 100.
6. In Germany in 1850, a total of 85.9 million letters and postcards and 40,000 telegrams were mailed. By 1873 the volume of mail had increased to 563 million letters and 10.8 million telegrams. Kocka, Unternehmensverwaltung, p. 45.
7. Johann Philipp Reis (1834–74) constructed the first operational electric telephone, which he demonstrated as the “wooden ear” to an assembly of the Association of Physicists in Frankfurt on October 26, 1861. The device exhibited by Reis was at that time considered to be only an interesting gadget for demonstration and soon fell into oblivion. About fifteen years later Alexander Graham Bell and Elisha Gray in the United States filed applications for patents for electromagnetic telephones. By the invention and refinement of the carbon microphone, Edison, Emile Berliner, and David Hughes in the United States and Blake in England made essential contributions to the improvement of the telephone service. On January 28, 1878, the first public telephone exchange in the world was opened in the United States in New Haven, Connecticut. The first telephone office in Ger-
many was opened on January 12, 1881, in Berlin. For data on the development of the telephone sector, see also the tables in the appendix.

8. Between 1885 and 1900 telephone charges dropped from 1 mark to 20 pfennigs per unit; the flat rate for the direct exchange lines was lowered with networks—which had up to fifty direct exchange lines—from 200 marks annually to 80 marks. Tilly, “Verkehrswesen,” p. 579.

9. The blight of the potato disease in 1845–46 and grain crop failures in 1846 and 1847 had led to famines in almost all parts of Germany. The excessive demand on the population’s purchasing power led to a failure in the demand for material goods, a development that affected the craft sector most severely; yet the investment goods industry, which had witnessed an impressive uptrend since the beginning of the 1840s, was also affected by slumps at the peak of the crisis. The policy of promoting the craft sector, which Prussia had vigorously pursued until 1844, was replaced by restrictive measures. Borchardt, Revolution, pp. 153, 159–60.

10. As a result of the so-called Gründerkrise, the Reichstag passed a customs tariff marking the end of the German free-trade policy and constituting the beginning of a tariff policy against foreign countries; restrictiveness thereafter tended to increase until the start of World War I. The tariffs began as a response to economic difficulties faced by the overexpanded heavy industry and the cotton-processing industry of southern Germany. Also, agriculture east of the Elbe River (in eastern Germany) began to suffer from competition for cheaper foreign foodstuffs.

13. In Germany this was true, for example, for the potash industry before 1914 and also for the dyestuff industry.

Chapter 2

1. Werner von Siemens, Lebenserinnerungen, pp. 13, 16.
2. There was no feasible relief from tariff duties, as there was in England and France, because Germany until the 1870s was a grain-exporting country that could not risk retaliation on its own farm products.
4. Werner to Carl, Charlottenburg, December 25, 1887, SAA WP Briefe.
5. Kocka, Unternehmer, p. 52; also pp. 30–34.
6. See, for example, the statement Johann Georg Siemens made about his son, then chief executive officer of the Deutsche Bank, as late as 1870: “My son, the clerk.” Hellferich, Georg von Siemens, vol. 3, pp. 153, 159.
8. SAA 2/Lr 68.
10. Wilhelm to Werner, Manchester, July 1, 1847, SAA WP Briefe.

Chapter 3

2. In the autumn of 1846 Werner Siemens had just begun analyzing the insulating qualities of gutta-percha, which had only recently been discovered. Jacketing a copper wire with gutta-percha met with difficulties at first. The problem was solved by the gutta-percha press, which was developed by Werner Siemens and Johann Georg Halske and consisted of a cylinder filled with heated gutta-percha, through which the wire was run while pressure was applied to the cylinder. Trendelenburg, Geschichte, p. 3.
3. On the organization of the state telegraph network, see Elektronische Zeitschrift, p. 31. The organization of the state telegraph network was begun in the following states and years:

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Great Britain</td>
<td>1845</td>
</tr>
<tr>
<td>Switzerland</td>
<td>1852</td>
</tr>
<tr>
<td>Sweden</td>
<td>1853</td>
</tr>
<tr>
<td>Norway</td>
<td>1855</td>
</tr>
<tr>
<td>Spain</td>
<td>1855</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>1852</td>
</tr>
<tr>
<td>Germany</td>
<td>1849</td>
</tr>
<tr>
<td>Austria</td>
<td>1849</td>
</tr>
<tr>
<td>Belgium</td>
<td>1849</td>
</tr>
<tr>
<td>Portugal</td>
<td>1855</td>
</tr>
</tbody>
</table>
6. Werner von Siemens, publicly describing the causes for the defects, recommended learning from the mistakes; yet he advised against changing hastily to the construction and use of overhead lines, since with the invention of the seamless lead shield for cables he had succeeded in greatly improving the outer insulation of the cables. Since the authorities feared his argument was biased, Werner von Siemens proposed “a careful comparative analysis of the results collected so far by scientific and competent experts.” Nottebohm in particular took this suggestion as a personal affront and canceled all state orders awarded to S & H.
8. In the 1860s the production of water meters proceeded favorably and the resulting profits were considerable. SAA 29/Lp 586.
10. Werner to Wilhelm, Paris, April 26, 1850, SAA WP Briefe.
11. The opening of a Siemens branch under the name of Siemens Frères in France in 1878 was a consequence of French patent legislation. According to this legislation, inventions for which patents were issued in France had to be produced there, within a certain time limit, if the claim for the patent was to be maintained. In 1886 this branch was closed, however, as the demand from French industry had not been as great as hoped. The losses of this branch were put at 1.3 million francs. Siemens later tried to open up the French market via cooperation with domestic firms. SAA 68/Li 177.
12. Quoted from Weiher, Carl von Siemens, p. 17.
13. Werner to Carl, Berlin, December 16, 1832, SAA WP Briefe.
15. Friedrichsort, July 25, 1848, SAA WP Briefe.
17. SAA 21/Li 53, Gesellschaftsverträge.
18. These numbers are a very cautious estimate taken from Kirchner, Deutsche Industrie, pp. 47ff.; for different figures see Weiher, Carl von Siemens, p. 16.
21. Carl to Werner, February 17, 1864, SAA WP Briefe.
22. Werner to Carl, April 2, 1881, SAA WP Briefe.
23. SAA 20/Ld 366, 2, p. 53.
24. Carl to Werner, February 16 and 28, 1881, SAA WP Briefe.
25. Werner to Carl, February 6, 1882, SAA WP Briefe.
27. Werner to Carl, March 21, 1887, SAA WP Briefe.
30. See "Beiträge zur Theorie der Legung und Untersuchung submariner Telegraphenleitungen," 1874; see also Werner von Siemens, Lebenserinnerungen, pp. 151–56.
31. For purposes of uniformity, Wilhelm—William—Siemens is called by the name Wilhelm throughout.
33. For Werner’s personal assessment of this misfortune, see Werner von Siemens, Lebenserinnerungen, p. 179.
34. See Werner’s complaints in his letters to Carl, e.g., May 20, 1863, and August 31, 1863, SAA WP Briefe.
35. Werner to Wilhelm, Berlin, May 7, 1864, SAA WP Briefe.
38. SAA 21/Li 53. Also see table 11 in the appendix, showing the surplus net profit distributed to the owners.
39. Werner to Carl, March 4, 1867, SAA WP Briefe.
40. See the letter from Werner to Wilhelm, January 18, 1859: “Already in this year we will make more profit because (as will be proved soon) of the piece-rate work which we have now introduced, and profits will surely increase as piece rates are used more and as we get more work” (SAA WP Briefe).

Chapter 4

1. Kocka, Unternehmensverwaltung, p. 117.
2. See Peschke, Elektroindustrie, pp. 48–56.
3. In 1831 Faraday demonstrated induction: if a conductor, e.g., a wire (or a wire wound into a coil), is moved through a magnetic field, a voltage will be generated in that conductor. Soon afterward the first electromagnetic machines were constructed, in which an armature (rotor) carrying coils rotated in the field of a permanent
magnet. Owing to the low intensity of the field of such a magnet (stator), only low electrical power was generated. Sometimes electromagnets with cores made of magnetically soft iron and fitted with coils energized by current drawn from external batteries were used, in place of permanent magnets, in the stator.

Werner von Siemens discovered that some magnetism (residual magnetism) remained in the iron cores if some direct current had passed, even for only an instant, through a coil enclosing the core. If an armature was rotated in the low residual field of a stator, a low voltage was induced in the armature. If a closed loop was set up and the initially low current driven by the low voltage was routed through the coils of the stator, the magnetic field of the stator was reinforced, and a correspondingly larger voltage was induced in the rotating armature. By this process of self-excitation, magnetism in the rotor and stator quickly increased until the iron cores were almost completely magnetically saturated. No longer were external batteries required for excitation of the magnets.

In his experiments Werner von Siemens made use of his experiences with a type of armature he had developed in 1856 during attempts to replace the expensive batteries necessary for operating long-distance telegraph lines. The iron core of this generator had a cross section of iron resembling two opposed capital letter Ts.

Although the pilot type of the “dynamomachine” built by Werner von Siemens had a maximum rating of only 50 watts and accordingly was just an experimental device, successive improvements to this machine created, within a few years, the basis for the tremendous growth of electrical power technology. The new technology permitted the efficient and convenient conversion of large amounts of mechanical energy into electrical energy, the distribution of electrical energy, and the simple reconversion of electrical into mechanical energy in factories and households.

At the end of 1875, the design of the slotted cylindrical armature with distributed windings and a commutator consisting of many prismatic segments, invented by Friedrich von Hefner-Alteneck, had reached a level of advancement allowing Siemens & Halske to offer a series of standardized generators with ratings of up to 5 kilowatts. A catalog describing these generators and quoting prices was published. In 1877 Siemens sold 91 of these machines; in the following year, 271; and in 1879, 351. While the quantity of machines produced remained more or less constant, their ratings increased almost exponentially in subsequent years. At the turn of the century, generators rating 1,000 kilowatts were sold.
4. See also table 4 in the appendix, showing the turnover in the time period 1847–96, divided by product groups.

5. Carl Frischen soon developed for Siemens & Halske a new signal system for railways, which achieved international acceptance. Later he was promoted to the position of director of manufacturing facilities.

6. "Oddly, Werner Siemens did not expect these people to become useful coworkers. Most likely in the later periods of his life he was unable to detach himself from the notion of one head alone, his own, as being sufficient for the scientific analysis of emerging problems. This concept had doubtless been mostly correct for his first two decades at the helm of his firm. Perhaps he also shared the mistrust of many self-made men against people who might make great demands right from the beginning of their employment, because of their educational background, that they would be entitled to only later and based on achievement" (Georg Siemens, Weg, vol. 1, p. 71).

7. For the growth in the number of employees, see tables 12–14 in the appendix.

8. For more details on the relationship between Berlin and London, see Weiher, Überseegeschäft.


10. Werner to Wilhelm, Berlin, August 14, 1867, SAA WP Briefe.

11. Werner to Carl, April 5, 1867, and Werner to Wilhelm, May 12, 1867, in Matschoß, Werner Siemens, vol. 1, pp. 26ff., 270ff.


13. Werner to Carl, Berlin, January 24, 1867, SAA WP Briefe.

14. Since the original documents were destroyed, the figures are quoted according to Ehrenberg, Unternehmungen, p. 264.


18. On the financial development of Siemens Brothers, see table 9 in the appendix.


21. Werner to Wilhelm, Berlin, December 5, 1878, in Matschoß, Werner Siemens, vol. 2, p. 582: "If there is no more to Edison's invention, it is not worth much."
22. Werner wrote to his brother Wilhelm on March 8, 1883: “In reality the German Edison Company will therefore be an installation agency for installing the machines, and the other materials (for transmission of electric power, etc.) we produce” (Matschoß, Werner Siemens, vol. 2, p. 771).

23. As Wilhelm von Siemens wrote, “The concept of growth in a greenhouse is alien to the spirit forming the base of the entire Siemens enterprise. This approach is easy to understand if the following fact is taken into consideration: The principal holder of shares of S & H, the Siemens family, which has the greatest influence on the management, cannot be interested in raising the capital of the company by offering more shares to the public. In fact, a conservative and merely manufacturers’ policy has been pursued” (SAA 4/Ld 147). Elsewhere Wilhelm von Siemens expressed the differences in the business policy of AEG and Siemens: “In all the life and activities of Rathenau I cannot find any outstanding achievement by Rathenau as an engineer that could be classified as being worthy of an engineer, i.e., any accomplishment making him appear to be an inventor or innovative designer opening new and previously unknown vistas. What he has achieved in the field of technology is merely the transplantation of American designs and methods of production into German soil, and their natural development” (SAA 11/Lb 569).

24. By means of a contract dated March 13, 1883, DEG obtained from Edison and his legal assigns the exclusive right for the use of Edison’s inventions within the territorial limits of the German Reich. Emil Rathenau planned to introduce incandescent lighting, the importance of which had not been fully recognized by Werner von Siemens, systematically in Berlin and throughout Germany.

Siemens & Halske acquired licenses on the Edison patents marketed by AEG, while DEG pledged in a contract to leave the manufacturing of generators, motors, cables, and instrumentation to Siemens & Halske. Siemens & Halske gave up the right to build central power stations to DEG. Owing to the terms of this contract, Siemens & Halske developed into a more and more specialized firm, providing equipment and accessories for central power stations. However, by 1887, shortly after it had been signed, both parties felt the contract to be obstructive to their business activities and agreed upon a revision. In 1894 all contractual commitments were annulled. For the corre-
spondence on this matter, with a detailed analysis of the reasons, see SAA 29/Li 435, 46/Lh 287; AEG Archives, minutes of the committee of the advisory board; Archive Deutsche Bank catalogue AEG S 76 and 79; "Fünfzig Jahre AEG," pp. 39ff.

25. For the beginnings of the Schuckert enterprise, see Keuth, Schuckert.

26. During the first stage of the enterprise, the technically oriented Sigmund Schuckert had concentrated on production. With the full entry of Alexander Wacker into the management of the firm, emphasis shifted onto financial affairs and onto the contracting business. Wacker had initially been Schuckert's general representative for the central and northern parts of Germany. See SAA 28/Li 987; Cohen, Schuckert, pp. 39ff.

27. Initially, owing to the small amount of initial capital required, ordinary partnership (offene Handelsgesellschaft—OHG) was the preferred legal structure of electrotechnical enterprises. At the end of the 1880s, many firms were converted into limited partnerships (Kommanditgesellschaft—KG). With the rapid growth of the electrical industry in the 1890s, numerous enterprises went public (Aktiengesellschaft—AG). Three corporations—AEG, Union-Elektrizitäts-Gesellschaft, and Helios—were founded directly as public companies. Fasolt, "Elektrizitätsgesellschaften," pp. 3ff.

28. In 1894 several banks founded the Association for Electrical Projects (Gesellschaft für Elektrische Unternehmungen) in order to finance the projects of the Union firm. Within a few years all large electrical companies had established at least one similar financing company. Feldenkirchen, "Finanzierung," p. 103.

29. See also the remarks in the memoirs of Felix Deutsch, the subsequent chief executive officer of AEG:

Particularly the newer of these firms had the idea of the "contractor business" of AEG as being very simple and obviously very lucrative, and engaged themselves intensively in this field. Whereas we, however, set about with great care and reserve, the rival firms, although—or, because—they did not by far have the same amount of resources and experience in the fields of technology, economics, and organization at their disposal as we had, plunged carelessly and wildly into all licenses and authorized exorbitant fees to be paid to the cities
and impossible conditions for the transfer of the plants to the municipal authorities. In addition, in our contracts with our affiliated firms we used to set the profit for the items we supplied at a very low rate, since we always had the profitability of the projects in mind, as from the very beginning it was clear to us that we could not continually reduce our liquidity by financing large central power stations with our own capital. Rather we tried to follow the concept of establishing such stations using our own resources, but as soon as possible leaving them to independent companies, in order to keep our capital liquid for new business activities. Consequently, we had to be careful to establish only sound and viable enterprises, whereas the competitors, contrary to our concept, saw their main business in charging their affiliated firms high prices, thus providing large earnings to the parent firm, without any concern for the economical operation and profitability of the power plants. (From documents in the Leo Baeck Institute, New York)

30. The first enterprises, such as the Berlin Electric Power Plants, concentrated chiefly on supplying electrical energy for illumination and only secondarily supplied firms with electrical energy for mechanical power. After the power plants were first put into operation, ten years passed before a noticeable increase in power consumption for mechanical purposes was registered. By about the end of the nineteenth century, the usage of electricity for operational purposes had become the dominant reason for the construction of new central electrical power plants. As most of the power stations were erected by the industrial enterprises themselves, the share of the public power stations in the total production of electrical energy dropped from 44.4% in 1891 to 19.5% in 1900.


32. In 1890 after the death of Carl Frischen, who had headed the railway department of Siemens & Halske, to meet the increasing demand the firm founded a separate central office for electric railways. Frischen, who had previously been director of the telegraph system of
the railways of the kingdom of Hanover in northern Germany, had in 1870 invented the track sectioning safety system for railways, a fundamental invention, which served as the basis for comprehensive railway safety systems later developed by Siemens & Halske. Such systems prevent collisions by keeping an oncoming train from entering a section of track on which there is already another train.

33. Years that horse-drawn and electric streetcar lines were started in German cities:

<table>
<thead>
<tr>
<th>City</th>
<th>Horse-drawn streetcars</th>
<th>Electric streetcars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berlin</td>
<td>1865</td>
<td>1879, 1896</td>
</tr>
<tr>
<td>Hamburg</td>
<td>1866</td>
<td>1893</td>
</tr>
<tr>
<td>Stuttgart</td>
<td>1868</td>
<td>1895</td>
</tr>
<tr>
<td>Leipzig</td>
<td>1872</td>
<td>1896</td>
</tr>
<tr>
<td>Frankfurt</td>
<td>1872</td>
<td>1884, 1899</td>
</tr>
<tr>
<td>Dresden</td>
<td>1872</td>
<td>1893</td>
</tr>
<tr>
<td>Hanover</td>
<td>1872</td>
<td>1893</td>
</tr>
<tr>
<td>Danzig</td>
<td>1873</td>
<td>1896</td>
</tr>
<tr>
<td>Wiesbaden</td>
<td>1875</td>
<td>1896</td>
</tr>
<tr>
<td>Düsseldorf</td>
<td>1876</td>
<td>1896</td>
</tr>
<tr>
<td>Elberfeld</td>
<td>1876</td>
<td>1896</td>
</tr>
<tr>
<td>Barmen</td>
<td>1876</td>
<td>1894</td>
</tr>
<tr>
<td>Munich</td>
<td>1876</td>
<td>1895</td>
</tr>
<tr>
<td>Karlsruhe</td>
<td>1877</td>
<td>1898</td>
</tr>
<tr>
<td>Cologne</td>
<td>1877</td>
<td>1901</td>
</tr>
<tr>
<td>Breslau</td>
<td>1877</td>
<td>1893</td>
</tr>
<tr>
<td>Kassel</td>
<td>1877</td>
<td>1898</td>
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<tr>
<td>Magdeburg</td>
<td>1877</td>
<td>1899</td>
</tr>
<tr>
<td>Mannheim</td>
<td>1878</td>
<td>1900</td>
</tr>
<tr>
<td>Aachen</td>
<td>1880</td>
<td>1895</td>
</tr>
<tr>
<td>Halle</td>
<td>1882</td>
<td>1891</td>
</tr>
</tbody>
</table>
34. See also Wilhelm von Siemens’s entry in his diary, December 26, 1902:

We, that is S & H, have often been reproached for having allowed AEG, Schuckert, Union, Lahmeyer, Brown Boveri to grow that large. But AEG became so large through their concession in Berlin, through which they earned some 50 million, and through the Deutsche Bank. They (AEG) were deliberately introduced to both opportunities by Werner Siemens under the slogan: S & H shall be the manufacturers and inventors, AEG the constructors. . . . S & H would have required hundreds of millions to control the situation. We have also stuck to our family policy and wanted to stay masters in our home. . . . During this period of time S & H has maintained a high level technically, and has in reality risen considerably when compared with the past era’s Frischen-Hefner. At present the technical reputation of S & H is at its peak. Besides, the enterprise rests on a secure and safe base. The financial affairs are in good shape, the cash deposits at the banks exceed 10 million. . . . The year 1903 will probably decide the question whether Rathenau intends to make additional sections of the industry financially dependent on him or whether S & H will come to some agreement with Schuckert in order to represent a greater counterbalance. The matter is being considered right now.

35. Union was founded by the Loewe, Thyssen, and Thomson-Houston International Electric Company. The firm Ludwig Loewe took over manufacturing. In 1897, 50% of all track and electrically powered streetcars of the electric railways in Europe were constructed according to the Thomson-Houston system. In 1898 Union purchased the electric factories from Ludwig Loewe. Union constructed streetcar systems in Erfurt, Leipzig, Barmen, Elberfeld, Elbing, Solingen, Düsseldorf, Duisburg, Berlin, Meissen, and Magdeburg (SAA 29/Ls 336). Since the 1880s, firms such as Aron, Mix & Genest, Voigt & Haefner—to name only a few active in the fields of electrical power technology as well as electrical signaling and communications technology—had been established, occupying special niches within the overall production. See Czada, *Elektroindustrie*, p. 43.


37. SAA 68/Lb 947.
38. See Werner von Siemens’s letter to Eugen von der Weyde, October 25, 1884, SAA 68/Lb 947, where further examples of rejections can be found.
39. SAA 16/La 92.
40. See contract with Rau to serve as a representative, June 21, 1882, SAA 68/Li 312.
41. SAA 68/Li 312.
42. Werner von Siemens to Carlo Moleschott, December 31, 1890, SAA 32/Lh 678.
44. In the 105th meeting of the third study group of subcommittee no. 3 for commerce, on May 14, 1929, the director general of Siemens & Halske, Dr. Adolf Franke, was asked by the experts, among other subjects, about the sales abroad and the marketing organization. Franke informed them that sales at home were organized by the Technical Offices, whereas sales abroad were organized by the firm’s own companies.

We created the system of the firm’s own companies, which in most places has resulted in a financially sound situation. We can keep a tighter rein on them, guide them in certain directions, and make their prices mandatory. They can be handled in a way impossible with an independent agent. This is the reason why we have extended this system all over the world, with the exception of a few countries, mainly in cooperation with Siemens-Schuckert [an enterprise formed after Werner’s death]. . . . They submit useful suggestions, and we receive more information about the activities of our competitors. We get better reports than from the agents, and thus new ideas.

. . . We experienced much better progress with companies of our own than with agents. This includes a lot of plants constructed and put into service by our own installation offices. There is also a lot of repair work taken care of immediately, on the spot, and in this respect as well, companies of our own are more useful for us than independent agents. (SAA 11/Lg 724, Franke’s official papers)
45. SAA 47/Lg 742.
46. The workshops established before 1863 in London and St. Petersburg took care of the maintenance and installation of products manufactured in Berlin.
48. SAA 23/Lk 677.
49. See tables 4 and 6 in the appendix showing S & H’s sales in different regions.
50. See Werner von Siemens, *Lebenserinnerungen*, p. 241: “I can only strongly advise proceeding in the same way in our colonial efforts. Simple people with extremely modest needs are averse to all cultural developments. Only after a desire for more elevated needs has been aroused and they have become used to work as a means to satisfy those needs will such people become receptive to social and religious and cultural endeavors. To start with the latter will merely produce illusory results.”
51. Wilhelm to Werner, June 28, 1868: “It would be preferable to set up the mutual agreements in such a fashion as to make the future course of our activities less dependent on the personal existence [of the participants], and when we meet next time we must endeavor to find such a solution! It would be unwise to reduce our activities, but it is more and more imperative to concentrate our energy on essential affairs, as has been shown by these losses but also by our awareness of our own deficiencies” (SAA WP Briefe).
52. Werner to Carl, Ragaz, July 17–18, 1868, SAA WP Briefe.

Chapter 5

1. See Werner’s letter to his son Wilhelm, February 3, 1877: “In my younger days it was particularly depressing for me to see so much poverty and misery at home and yet to be unable to help alleviate these conditions and to have little prospect of being capable of doing so in later years. Admittedly, these circumstances were also a great spur for me to work hard” (SAA WP Briefe).
2. Charlottenburg, December 25, 1887, SAA WP Briefe.
3. Carl to Werner, St. Petersburg, December 21, 1887, SAA WP Briefe.
5. For more detailed information on these problems, see Weiher, *Überseegeschäft*, pp. 131–37.
8. Carl to Werner, St. Petersburg, December 21, 1887: "Why should we accept strangers as replacements for people who have passed away? After my death, according to my last will, my son will replace me and you will probably do the same with your sons. What strangers mean, we have seen with Löffler and Louis S." (SAA WP Briefe).

9. Werner to Carl, Charlottenburg, December 25, 1887, SAA WP Briefe.


11. Limited partnership agreement, St. Petersburg, December 27, 1889; Berlin, January 10, 1890, paragraph 13, SAA 21/Li 53.

12. See letter from Werner to Carl, November 22, 1854: "There is a shortage of mechanics. . . . It is difficult to find reliable workers" (SAA WP Briefe)


14. Within the personnel of the Telegraph System Construction Enterprise, members of the following groups rated as key officials: persons holding the power of attorney, accountants, heads of workshops, cashiers, file clerks, workshop masters, workshop writers, persons in charge of materials, designers, and office staff.

15. Until 1872 the enterprise had not adopted any internal administrative regulations or guidelines at all. Starting in 1860, the first person holding the power of attorney, senior engineer William Meyer, who had increasingly taken over the internal management of the enterprise, received 5% of the profit from the total business as a reward. Carl Haase, the accountant who structured the bookkeeping of the firm into a system that remained in use well into the twentieth century, received 2.5% of the profits from the Berlin business, as did the head of the workshop, Weiss.


17. Werner to Carl, July 18, 1868, SAA WP Briefe.

18. Conrad, Erfolgsbeteiligung, p. 120; Czada, Elektroindustrie, p. 119.


20. For this reason, Werner von Siemens regarded the firm’s insurance programs also as an apt means to fight against the “strike mania” (Streikmanie). See Werner von Siemens, Lebenserinnerungen, p. 201.


22. SAA WP Briefe.

23. Werner von Siemens, Lebenserinnerungen, p. 207.

Chapter 6

1. As well as the Deutsche Bank, the Mitteldeutsche Credit–Bank acted for Siemens & Halske between 1890 and 1929, when the merger with the Commerz- und Privatbank took place. This bank also participated in the founding of electrical enterprises in Germany, Switzerland, Russia, and Brazil. Other banks became important to a greater extent for Siemens in the 1920s. See SAA 11/Lh 504; BA Potsdam, Ba 2, Deutsche Bank No. 18855.

2. Weih and Goetzeler, Weg, p. 44.


4. For this reason, Georg Siemens resigned from his post as a member of the supervisory board of AEG. Archive of the Deutsche Bank, Siemens Cash Assets, p. 1348.

5. Note also the opinion expressed by Georg Siemens of the Deutsche Bank on the business rules of Siemens & Halske AG: “I have never seen such a brake as this instruction. The theory of the law requires the supervisory board to supervise, or to know everything; the theory of the draft of the business rules of Siemens & Halske requires the supervisory board to possess the [sole] authority to approve everything, without it nothing may be done. By these means all jurisdiction of the top management is wiped out. As the representative of the Deutsche Bank I would advise against long-term agreements with an institution managed in such a fashion.” The following definition in the rules was responsible for such an attitude:

In order to achieve uniform handling of the business operations in the individual divisions and a purposeful cooperation between the divisions involved in an individual case, the supervisory board will appoint a delegate. He will be vested with the right to order a different allocation of the business operations and particularly to appoint, in addition to the responsible supervisors installed according to the business rules, additional supervisors on special occasions. This delegate, by executing the right the supervisory board and its chairman are entitled to, will moreover be authorized to supervise the entire conduct of business of the board of management and also to issue instructions to the board of management. With respect to decisions on fundamental problems, the department heads will get in touch with this delegate in time. This applies particularly to matters affecting the spheres of several divisions. (SAA 33/Ld 603)
The first board of management was composed exclusively of members of the Siemens family. In the spring of 1898, A. von Gwinner from the Deutsche Bank was elected to the board, and later Carl Klööne, on April 19, 1900. After Roland Lücke joined the board in January 1901, Gwinner resigned on January 4, 1902, since Deutsche Bank disapproved of three directors of the bank being members of the supervisory board of a single company at the same time. BA Potsdam, Assets 80, Ba 2, Deutsche Bank No. 18850.

6. SAA 33/Ld 603.

7. Georg Siemens, Weg, vol. 1, p. 188.

8. Georg Siemens, Weg, vol. 1, pp. 132ff. Also compare paragraph 25 quoted above with the following comment by Wilhelm von Siemens: “The organization of our company indeed exhibits an abnormality due to the historical and financial position of the Siemens family in the company. We formed a corporation in 1897 but kept all our shares and have taken out new ones. We did not intend to give up our leading positions in the firm; on the contrary, we considered the further conduct of the business as our principal assignment in life. We expected to preserve our inheritance and all the responsibility connected with it, if at all possible, even beyond our generation. We would not have founded SSW corporation in such a way that would have made it impossible to preserve our top management positions.”

9. According to the annual report of AEG for 1902/03, in 1902 Siemens, AEG, and the Felton & Guilleaume Group combined held a share of three-quarters of Germany’s electrotechnical production.

10. In answer to a committee conducting a survey, Carl Friedrich von Siemens attributed Schuckert’s difficulties above all to its engagement in the electrochemical industry; yet its considerable engagement in the contractor business might well have had an even more important influence. See “Verhandlungen,” pp. 409ff.

11. See SAA 69/Lr 515; 11/Le 862; “Fünfzig Jahre AEG,” pp. 149ff. Also see notes by Felix Deutsch in the Leo Baeck Institute, New York.

12. In 1901–2 there were long-drawn-out negotiations between AEG and Schuckert over establishing an association with common interests, possibly later resulting in a merger. The banks represented in the Schuckert syndicate pursued this course owing to the unfavorable financial development of the company. In 1902 the negotiations were considered to have failed and were discontinued. On January 14, 1903, Roland Lücke, a board member of the Deutsche Bank and member of the supervisory board of Siemens & Halske, started confidential preliminary talks with the privy councillor A. von Rieppel, a
member of the supervisory board of Schuckert who had also conducted the negotiations with AEG. At another conference on the same day, Wilhelm von Siemens declared that his firm was in no real need of such a merger, but that the activities of AEG would make it advisable. According to a report by von Rieppel, the merger with AEG would have taken place had the financing business of Schuckert and the great volume of stock of the financing company Continental Company for Electrical Endeavors (Continentele Gesellschaft für Elektrische Unternehmungen) not deterred AEG and caused it to withdraw. See SAA 28/Li 987.

13. See SAA 4/Lf 682; 722; Riesser, Großbanken, pp. 544ff.; Feldenkirchen, “Finanzierung,” pp. 101ff. A marginal note by the director of the Deutsche Bank, Carl Klönne, jotted down on a letter from Dr. O. von Petri, the director of SSW, April 24, 1912, may provide a clearer picture of the conditions resulting in the founding of SSW: “If Petri sees the SSW’s main source of income, soon after its founding, in Nuremberg, this would be a strange perception. In any case, the improvement in the Nuremberg results was caused by the energetic initiative of the Berlin management, the appropriate transfer of certain production lines to Nuremberg, shifting the production of other items to Berlin, in short, by the totally new organization.—It should not be forgotten that Schuckert was almost bankrupt when Rieppel approached Lücke for help.”

14. BA Potsdam, Assets 80, Ba 2, Deutsche Bank No. 18850.

15. See Czada, Elektroindustrie, p. 50.


Please avoid using the phrase Siemens-Schuckert Concern. The term concern connotes something indefinite, nothing that is pleasant. Our company and the Schuckert Company, at any rate, do not make up a concern as expressed in common usage. We are two companies operating completely independently of one another. They are united neither by common capital nor by any associations in the management. Also, the activities of the two companies are generally different. Our company is purely industrial, whereas the Schuckert Company operates mostly as a contractor. The common denominator of the [two] different [establishments] Siemens and Schuckert in Germany consists in the fact that both are partners in a private limited company. For us this part in the part-
nership does not have the character of a portfolio investment, as, for example, a bank would classify such a form in its books, but it is a part, a most important one at that, of the comprehensive industrial enterprise. We have, in order to preserve this structure, at the occasion of the founding of SSW, expressly reserved for ourselves the right to keep the legal seat in Berlin and the majority share of the partnership, and also on the supervisory board, in that S & H has the statutory right to appoint the chairman, and his vote also secures the majority. . . . We consider it most important not to have the matter presented as if S & H had split their enterprise into different companies and the common link were to be made up only of different partnerships. On the contrary, the centralized management of the centralized enterprise has been cultivated to an even greater extent than had been the case before. We chose this way only because we did not want to create too great a number of new S & H stockholders.

(SAA 54/L1 618)

17. SAA 69/Lr 515.

18. The legal structure of a private limited company, chosen at the founding of SSW, was not based on concerns over taxation, even though the obligation for limited companies to pay income tax had only been introduced in Prussia in 1906. As Siemens & Halske and Schuckert had committed themselves to conduct their entire business in the field of electric power from the company's own capital, creating new stock and offering the shares to the public to finance the new company would have constituted an increase in number of shares, and thus a dilution of the stock of the company. If no shares were offered, the status of a public corporation made no sense for the time being. See Findeisen, Unternehmensform, p. 128; Brandstetter, "Finanzierungsmethoden," p. 63.

19. SAA 37/Lp 872.

20. For the policy concerning the annual balance, see also SAA 20/La 246.

21. For information on the financing of enterprises, see Feldenkirchen, "Finanzierung," and also "Zwischenkriegszeit." For the development of the workforce and for sales figures of Siemens & Halske and SSW in the period of time between 1903/04 and 1913/14, refer to the tables in the appendix.
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Photos were taken from the Siemens Archives. The graphs are based on data in the tables in the appendix.

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