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GRADE / DEGREE:	ANNÉE D'OBTENTION / YEAR GRANTED
M.A. (History)	2003
TITRE DE LA THÈSE / TITLE OF THESIS: THE TECHNOLOGY GAP AND THE EMERGENCE OF FRENCH AND GERMAN INDUSTRIAL POLICY IN THE DOMAIN OF DATA PROCESSING AND COMPUTERS, 1960 - 1970	

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TITRE DE LA THÈSE - TITLE OF THE THESIS

The Technology Gap and the Emergence of French and German Industrial
Policy in the Domain of Data Processing and Computers, 1960-1970

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**The Technology Gap
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M.A. Thesis

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Abstract

The idea that a technology gap between the United States of America and Western Europe existed emerged in the early 1960s. Western Europeans attributed the gap to a dramatic increase in direct American investment, government support for R and D, firm size, as well as the brain drain, while American Scholars argued that the roots of the gap were the archaic educational systems and the hierarchical social structures of Western Europe. In order to support their national computer industries against American competition, French and German policy makers chose to counter the technology gap by developing national support programs.

Although both countries responded to the same socio-economic problem, the resulting industrial programs differed fundamentally. The purpose of this study is to gain an understanding of industrial policy in the 1960s and, through a comparative analysis show, how industrial policy is shaped by political and cultural aspects within individual countries.

Acknowledgements:

For my husband Serge and
my sons Michael and Stephan.

Thank you for the support and understanding
while I was going through process of researching and writing this thesis.

Thank you to my thesis supervisor, Eda Kranakis, without her
guidance, support and patience I could not have completed this study.
Thank you also for giving me access to her collection of documents on the
German Federal Support Pogram and the French Plan Calcul.

Thank you to the staff at the Federal Archives
In Koblenz, Germany for their assistance.

Thank you also to my neighbour
Terry Hill
for editing the final version of this paper.

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CHAPTER 1:

Introduction

The technology gap of the mid-1960s was a symptom of the shift in economic power from Western Europe to the United States (U.S.) that further intensified after World War II. The publication of Servan-Schreiber's book The American Challenge¹, in 1968 publicized the technology gap and drew attention to the issues related to it. However, Western European governments had been aware of the problems associated with the technology gap prior to the publication of Schreiber's book and they developed and implemented industrial policies to counter its effects as early as 1967. This study consists of a comparative analysis of industrial policies implemented by France and West Germany in response to the technology gap of the mid-1960s. Despite the fact that the two countries responded to the same socio-economic problem, the policies and programs they devised differed considerably.

Definition of Industrial Policy

Industrial policy is difficult to define because it potentially includes so many different aspects of government support for industry. Steven J. Warnecke, for example, points out that the term "has been used indiscriminately to include all policies that can aid industry, and has raised the expectation that there can be a policy which is universally applicable."² Steven A. Shull and Jeffrey A. Cohen think of industrial policy "as any

¹ J.-J. Servan-Schreiber, The American Challenge (New York: Atheneum House, Inc., 1968). Published in 1967 in France under the title Le Défi Américain.

² Steven J. Warnecke, "Introduction," Industrial Policies in Western Europe, eds. Steven J. Warnecke and Ezra N. Suleiman (New York: Praeger Publishers, 1975), p. 5.

government policy designed to promote or facilitate changes in the operation of the economy."³ Within the context of this thesis, Wayne Sandholtz's definition of industrial policy as "the efforts of governments to influence the allocation of resources among or within industrial sectors,"⁴ has been applied because it defines German and French industrial policy of the 1960s most accurately.

The post World War II period was a major turning point and a period of tremendous economic growth that was associated with the development of new technologies. Although the technology gap spanned all aspects of the economy, it was in the computer industry that it was most prominent. At the time, the computer industry was viewed as the engine for economic growth and Western Europeans perceived their inability to keep pace with American computer development as a grave threat to their economic and political independence. Yet, despite the economic importance of computer technology in the 1960s as well as today, we know very little about how governments developed and implemented programs to support technological innovation in this domain.

Historiography

Some key studies on industrial policy in the domain of computer technology exist. British industrial policy of the 1960s and in particular the role of the British government in the development of computer technology, has been examined by John Hendry and Martin

³ Steven A. Shull and Jeffrey E. Cohen, Economics and Politics of Industrial Policy: The United States and Western Europe, (Boulder and London: Westview Press, 1986), p. 2.

⁴ Wayne Sandholtz, High-Tech Europe, The Politics of International Cooperation, (Berkeley: University of California Press, 1992), p. 66.

Campbell-Kelly.⁵ The general consensus is that the British government played an important role in the creation of a viable British computer industry. With the same perspective, Christopher Freeman examines how Japan has closed its technology gap of the 1950s and 1960s with the U.S. and Europe.⁶

In contrast, French and German industrial policies in the domain of computers have not been analyzed in depth. Western European industrial policy of the 1960s is often referred to as the 'National Champion Policy'⁷, describing the goal of European policy makers to create large companies that would be able to compete with the American giants in the international market place. Based on very few primary sources such as the OECD report 'Gaps in Technology' and Servan-Schreiber's book, The American Challenge, this theory equates Western European industrial policy of the 1960s with economic nationalism.

Little is known about German industrial policy in general. The dominant themes in the existing literature on German industrial policy focus on the theoretical aspects of the Social Market economy, the shift in economic policy that was the result of a change in

⁵ Martin Campbell-Kelly, ICL: A Business and Technical History (Oxford: Clarendon Press, 1989). Kenneth Flamm, Creating the Computer; Government, Industry, and High Technology (Washington: The Brookings Institution, 1988). John Hendry, Innovating for Failure; Government Policy and the Early Computer Industry (Cambridge and London: MIT Press, 1990). Jill Hills, Information Technology and Industrial Policy (London: Croom Helm, Ltd., 1984).

⁶ Christopher Freeman, Technology Policy and Economic Performance, Lessons from Japan (London and New York: Pinter Publishers, 1987).

⁷ Wayne Sandholtz, High-Tech Europe, The Politics of International Cooperation, pp. 59 - 71; Kenneth Flamm, Creating the Computer: Government, Industry, and High Technology (Washington: The Brookings Institution, 1988).

government in 1966, and the recession of 1966/67.⁸ A more comprehensive study by Dr. Ulrich Brösse examines the evolution of German industrial policy and how it coincides with industrial policy at the European level.⁹

The situation is similar in the case of French industrial policy. A dominant theme in the existing literature on French industrial policy is economic planning and the relationship between industry and the state.¹⁰ French industrial policy is frequently linked to the French *dirigiste* tradition, which is rooted in mercantilist ideology and the central state structure,¹¹ while the roots of government intervention are linked to economic

⁸ Ernst-Jürgen Horn, 'Germany: a market-led process', in Managing Industrial Change in Western Europe, Eds. François Duchene and Geoffrey Shepherd (Frances Printer (Publishers): London and New York, 1987); Gerhard Wagenhals, 'Industrial Policy in the Federal Republic of Germany: A Survey', in Industrial Policies for Growth and Competitiveness, Eds. F. Gerard Adams and Lawrence R. Klein (Lexington Books: Massachusetts and Toronto, 1983), pp. 247 - 262; Fels, Gerhard. "Effective Protection of German Industry", in Public Assistance to Industry. (Boulder, Colorado: Westview Press, 1976); Georg H. Küster "Germany" in Big Business and the State; Changing Relations in Western Europe, ed. Raymond Vernon (Harvard University Press: Cambridge Massachusetts, 1974), pp. 64-86. Alphonse Losser, "La politique industrielle en république fédérale d'Allemagne", Revue d'Allemagne (France), 1990 22 (2). In addition, the survey by the Organization for Economic Co-operation and Development, The Industrial Policies of 14 Member Countries (Paris: 1971), may also be of interest.

⁹ Ulrich Brösse, Industriepolitik, (München und Wien: R. Oldenburg Verlag, 1996).

¹⁰ John McArthur and Bruce R. Scott, Industrial Planning in France (Boston: Harvard College, 1969); Although somewhat dated this study provides a good overview of French economic planning. Stephen Cohen. Modern Capitalist Planning: the French Model (Cambridge, Mass.: Harvard University Press, 1968). Jean-Jacques Bonnaud, "Planning in Industry," in Planning and Politics. Eds. Jack Hayward and Michael Watson (London: Cambridge University Press, 1975. Saul Estrin and Peter Holmes, French Planning in Theory and Practice (London: George Allan & Unwin, 1983).

¹¹ Jill Hills, Information Technology and Industrial Policy, (London & Canberra: Croom Hel, Ltd., 1984), pp. 33-35. This view is widely accepted by political scientists. William James Adams and Christian Stoffaes, eds. French Industrial Policy, (Washington, D.C.: The Brookings Institution, 1986). Jack Hayward, The State and the Market

planning and the central state structure of France.¹² John Zysman's study analyzed the French electronics industry within the context of the business-state structure that was particular to France.¹³ A number of studies include only brief overviews on German and French industrial policy in the domain of computers.¹⁴ However, all of these studies give only general overviews of German and French industrial policy.

Case studies that analyze the development of industrial policy in relation to cultural aspects of a country are non-existent. The two published comparative studies on industrial policy that do exist,¹⁵ fail to make the correlation between industrial policy and

Economy; Industrial Patriotism and Economic Intervention in France (New York: New York University Press, 1986);

¹² Ezra N. Suleiman, 'Introduction,' Industrial Policies in Europe, Eds. Steven J. Warnecke and Ezra N. Suleiman (Praeger Publishers: New York, Washington, London, 1975); Charles-Albert Michalet, "France", in Big Business and the State; Changing Relations in Western Europe, Ed. Raymond Vernon (Harvard University Press: Cambridge, Massachusetts, 1974). John Zysman, Political Strategies for Industrial Order; State, Market and Industry in France (Berkeley: University of California Press, 1977). Henry Aujac, "An Introduction to French Industrial Policy," French Industrial Policy, eds. William Adams James and Christian Stoffaes, (Washington, D.C.: The Brookings Institution, 1986). Yves Ullmo, "France," Planning, Politics and Public Policy, Jack Hayward and Michael Watson, eds. (London: Cambridge University Press, 1975). Jean-Jacques Bonnaud, "Planning and Industry," in Planning, Policy, and Politics, eds. Jack Hayward and Michael Watson, (London: Cambridge University Press, 1975).

¹³ John Zysman, Political Strategies for Industrial Order; State, Market and Industry in France (Berkeley: University of California Press, 1977). John Zysman, "The French Electronics Policy: The Costs of Technological Independence," in Industrial Policies in Western Europe, eds. Stephen J. Warnecke and Ezra N. Suleiman (New York: Praeger Publishers, 1975): 227-245.

¹⁴ Annemieke J.M. Roobek, Beyond the Technology Race; an Analysis of Technology Policy in Seven Industrial Countries (Amsterdam, The Netherland School of Business. 1990), pp. 210 -218; and Wayne Sandholtz, High-Tech Europe, p. 77.

¹⁵ Wolfgang Neumann und Henrik Uterwedde, 'Industrie- und Technologiepolitik in Frankreich und Deutschland seit 1945', in Frankreich und Deutschland, Forschung

culture. Yet it is important to gain a perspective on how industrial policies are formulated and implemented in different countries. Policy makers develop industrial policies with the notion that they are responding to economic indicators and they fail to recognize that the formulation and implementation of industrial policies are greatly influenced by cultural factors.

It is the purpose of this study to gain an understanding of industrial policy of the mid-1960s by analyzing and comparing the development and implementation of industrial policies in the computer sectors of West Germany and France. Although implemented in response to the same socio-economic issue, namely the technology gap, the policy programs resulting from government support in Germany and France differed fundamentally from each other. This may be explained, in part, by the different ideological environments in which the programs were developed and implemented. The German federal support program was developed within the context of the Social Market Economy, while the French *Plan Calcul* was conceived and implemented within the context of the Fifth Economic Plan.

Technologie und industrielle Entwicklung im 19. und 20. Jahrhundert (München und Paris: Deutsches Historisches Institut, 1990), pp. 433-449; in a brief overview of French and German industrial and technology policy the authors argue that the variation of industrial policy in the two countries is a result of the historical development.

Alan Peacock analyzes and compares structural measures in the areas of employment, export and import substitution and investment in fixed capital R and D taken in the Federal Republic of Germany and Great Britain. His study comprises a general analysis and comparison of how the two governments encouraged investments in capital R and D in the computer industry in the two countries. Alan Peacock, Structural Economic Policies in West Germany and the United Kingdom (London: Anglo-German Foundation for the Study of Industrial Society, 1980).

In addition to the ideological environment, the political environment also shaped industrial policy in West Germany and France. This thesis will trace the development of the West German Federal Support Program within the context of the German federal state structure, thus taking into account how the various players within the federal system interacted. The Federal Support Program for Data Processing was developed and implemented within the jurisdiction of the Federal government and its de-centralized structure and allowed several government departments to provide input under the leadership of the Ministry of Scientific Research.

On the other hand, this thesis will explore the development of the French *Plan Calcul* within the context of the centralized state structure of France under the direct leadership of General Charles de Gaulle and how these aspects influenced the structure of the program. A third aspect that will be considered is the lack of a significant military establishment in West Germany, which could have formed the back-drop for the development of computer technology. In comparison, France had an established military program which provided a context for government support. It is the purpose of this study to evaluate how all of these factors contributed to the development of a distinct industrial policy in each country.

Servan-Schreiber

The publication of Jean-Jacques Servan-Schreiber's book, Le Défi Américain in October 1967, drew public attention to the 'technology gap' between the U.S. and Western Europe. The book was an instant bestseller with 159,000 copies sold during the first four

weeks after its publication in France.¹⁶ With its prediction that "fifteen years from now it is quite possible that the world's greatest industrial power, just after the United States and Russia, will not be Europe, but American industry in Europe,"¹⁷ Servan-Schreiber's book evoked a sense of crisis among Western Europeans. In the Foreword to the book, Arthur Schlesinger, Jr. states that "throughout Europe politicians, and civil servants, editors and professors, bankers, industrialists and engineers are studying and quoting it."¹⁸ The book gave expression to fears related to a dramatic increase in American direct investment that occurred after the creation of the European Economic Community (EEC) in 1958,¹⁹ when American businesses invested in strategically important economic sectors by establishing subsidiaries and by buying shares in existing European firms.

Servan-Schreiber gave particular attention to the economic importance of the computer industry. He quoted Jacques Maisonrouge, the French president of IBM²⁰-World Trade, who pointed to the computer industry as "the most important industry in the world after oil and automobiles".²¹ Servan-Schreiber also noted that John Diebold, the head of an international management consulting firm, predicted that "by 1970 computers

¹⁶ Gene Bradley, 'The American Challenge', The Atlantic Community Quarterly, (Winter 1967-1968), p. 520.

¹⁷ Servan-Schreiber, The American Challenge, p. 3.

¹⁸ Arthur Schlesinger, Jr., "Foreword", in J.-J. Servan Schreiber, The American Challenge (New York: Atheneum House, Inc., 1968), p. vii.

¹⁹ Member countries of the EEC were France, Germany, Italy and the Benelux Countries.

²⁰ International Business Machines.

²¹ Quoted in Servan-Schreiber, The American Challenge, p. 134.

will be the biggest single investment expense for a corporation, comprising at least 10 per cent of its total investment."²² In essence, Servan-Schreiber stressed that the development of computer technology was a key for future economic growth for Western Europe and that, unless Western Europeans took action, they would become mere satellites of the United States.

System/360:

Western European governments began to be aware of the issues related to the technology gap several years prior to the publication of Servan-Schreiber's book. The real wake-up call came with the announcement of IBM's System/360 in April 1964,²³ which caught them completely off guard. At this stage in the development of computers, computer firms produced a number of 2nd generation models, each employing an independent operating system, which made them incompatible.²⁴ As a result, firms had to develop individual programs for each machine, making it very expensive to produce and to own a computer.

System/360 was the culmination of a \$5 billion investment by the American computer firm IBM²⁵ that promised to revolutionize the computer industry. It is difficult

²² Servan-Schreiber, The American Challenge, p. 134

²³ Katharine Davis Fishman, The Computer Establishment (New York: Harper and Row Publishers, 1981), p. 100; Kenneth Flamm, Creating the Computer; Government, Industry and High Technology, p. 97.

²⁴ B/138 7680 Kommission der Europäischen Gemeinschaften, Sectoral Strukturpolitik, Elektronische Industrie, Dokument für den Ausschuss für mittelfristige Wirtschaftspolitik (Brüssel: 25 Juli 1967), p. 11.

²⁵ Fishman, The Computer Establishment, p. 92.

to find the words to adequately describe the impact that System/360 had at the time - suffice it to say that the industry was awed by this incredible achievement. System/360 was a third-generation modular computer system, consisting of computers of different sizes that shared the same operating system, which made them compatible. Customers whose requirements outgrew the capabilities of a particular sized computer no longer had to purchase an entirely new system including new software and peripherals. Instead, they could increase capacity simply through the addition of a larger machine in the series, which could function with the existing software and peripherals.²⁶ In short, System/360 was a major challenge to the entire computer industry, but in particular to the smaller Western European firms, which were already struggling to stay in business. The 1964 announcement of System/360 meant that IBM, the firm that already controlled a considerable share of the world market in computers,²⁷ would very likely gain nearly complete control of the market. Within two years of the announcement, IBM set up new manufacturing programs in France, West Germany and Great Britain.²⁸

Trade Liberalization

In addition to the announcement of System/360 in 1964, Western European states also faced considerable challenges associated with trade liberalization. World War II was the beginning of a new economic order, with the United States providing leadership. The

²⁶ Kommission der Europäischen Gemeinschaften, Sectoral Strukturpolitik, Elektronische Industrie, p. 11.

²⁷ Doc 2893, Report on the Computer Industry in Europe: Hardware Manufacturing (Strasbourg, 1971), p. 8. More specifically, in 1966, IBM controlled 62.5% of the French market and 82% of the German computer market.

²⁸ Fishman, The Computer Establishment, p. 92

U.S. favoured a multilateral free trade system and pursued this goal aggressively through several rounds of negotiations. The first round of negotiations for the General Agreement on Tariffs and Trade (GATT) took place in 1947, when twenty-three participating countries promised to sign on.²⁹ During the third round of negotiations, the Kennedy Round of GATT (1964-67), tariffs on industrial goods were reduced by thirty per cent.³⁰ However, as trade barriers were reduced or eliminated, Western European computer firms found it increasingly difficult to compete with American firms in the world market.

In addition to trade liberalization talks, Western European firms faced fierce competition from American firms that established themselves within the European Economic Community (EEC). At the same time, it was to be protected from outside competition by an external tariff barrier. American firms were searching for inroads into the new and growing market of the EEC. The EEC was created in 1958³¹ to allow free movement of services, capital and labour within its borders.³² To gain access to the EEC, while avoiding customs duties, American businesses invested in strategically important economic sectors by establishing subsidiaries and by buying shares in existing European

²⁹ Herman Van der Wee, Prosperity and Upheaval; the World Economy, 1945-1980; Translated by Robin Hogg and Max R. Hall, (Berkeley, Los Angeles: University of California Press, 1986), p. 349.

³⁰ Desmond Dinan; An Ever Closer Union; An Introduction to the European Community (Boulder, Colorado: Lynne Rienner Publishers, 1994), p. 440.

³¹ Member states of the EEC were France, Germany, Italy and the Benelux countries.

³² Herman Van der Wee, Prosperity and Upheaval; the World Economy, 1945 - 1980, p. 367.

firms. The computer sector in Western Europe, as in the U.S., was a particularly high-growth sector that attracted a number of American computer firms

The creation of the EEC also led the way for competition within the Western European computer industry. In his book, Servan-Schreiber argued that European countries would have to cooperate in order to compete effectively with American computer firms. However, the French and West German governments instead instituted individual programs to strengthen their national computer industries as each country attempted to assert its dominance within the EEC.

Structure:

The structure of this thesis is as follows: Chapter 2 explores the issues surrounding the technology gap. The source material for this chapter consists of contemporary books and articles written on the subject of the technology gap and direct American investment. Jean-Jacques Servan-Schreiber's American Challenge and Rainer Hellman's Amerika auf dem Europamarkt, are only two examples of the body of literature used to discuss the issues related to the technology gap. This chapter explores how Western European governments in general perceived the threat of American domination in the domain of computer technology and how they defined the technology gap.

Chapter 3 explores the response of West German policy makers based on archival records from the *Bundesministerium für wissenschaftliche Forschung, Fachbeirat für Datenverarbeitung* (Federal Ministry for Scientific Research, Council for Data-Processing) dated 1964 to 1969. These sources contain numerous government reports that formed the basis for the Federal Support Program for Data Processing, internal departmental memoranda, correspondence between Minister of Scientific Research,

Gerhard Stoltenberg and Minister of Economics, Karl Schiller, which are related to the development of the support program. General correspondence between the Ministry of Scientific Research, the Deutsche Forschungsgemeinschaft (DFG)³³ and other non-governmental organizations is also included. The records contain the all important memorandum written by representatives from the two largest German firms indicating that the German computer industry could no longer hold its own without government assistance. Minutes of internal departmental meetings at the Ministry of Scientific Research and the Ministry of Economics hammer out the fundamentals of what the program should and should not be (sometimes industry had representatives at these meetings), while Minutes of interdepartmental meetings are records of the discussions of the needs and expectations of numerous departments. The records also contain the Minutes of the Expert Council for Data Processing, which was responsible for administering the program. Attached to these minutes are records of which proposals submitted by German data processing firms were accepted and the reasons for acceptance or rejection. The records also include excerpts from *Bundestag* meetings on the discussions related to the development of the program. Last, but not least the blueprint for the program itself is included.

Based on these records, this chapter traces the evolution and early functioning of the West German Federal Support Program for Data Processing. To put German industrial policy into the political and economic context, Chapter 3 also considers the tenets of the Social Market Economy and how the German Program evolved within the context of this political ideology.

³³ The German Research Society

Chapter 4 briefly explores the development of the French computer support program within the context of the fifth economic plan. The blueprint for the French program, the *Plan Calcul*, as well as numerous other government documents and reports, permit me to trace the evolution as well as the formulation of the French industrial policy program within the context of French economic planning and General de Gaulle's nationalistic aspirations. Chapter 5 compares and contrasts the two programs in relation to the technology gap and offers some conclusions.

The study focuses on German industrial policy, while the French case will serve to provide a perspective for comparison. It should be noted that the documentation for French industrial policy is not as complete as that for the German policy. However, the sources do include the key documents to establish the development and early functioning of the French program, and as such it will serve as a solid basis for comparison with German industrial policy.

CHAPTER 2:

Defining the Problem: The Technology Gap

Introduction:

In his article, "A Political Interpretation of the Technology Gap Dispute," Henry R. Nau pointed out that "[t]he issue most widely understood under the term "technology gap" had its origins in the publication of an OECD report in November 1965 showing a 4:1 gap in R&D expenditures between the United States and the major West European states combined."¹ The report entitled, The Research and Development Effort in Western Europe, North America and the Soviet Union was completed by C. Freeman and A. Young. A first attempt to quantify and compare R and D efforts of several OECD countries, its purpose was to present and compare data on the resources devoted to R and D in the U.S., U.S.S.R. and Western Europe. While the issues related to the technology gap were not new, Freeman and Young's report provided statistical evidence to support the argument that a technology gap between the United States and Europe existed.

By the mid-1960s, R and D, among other things, was viewed as an important determinant of economic growth. Until World War II, investment in new machinery to rationalize production processes in manufacturing industries was widely considered to be a key source of economic growth. By the mid-1960s, economists began to explore the importance of investment in R and D as a source of economic growth in the science-based industries. The OECD report Gaps in Technology states that "a new group of industries

¹ Nau, Henry N. "A Political Interpretation of the Technology Gap Dispute," Orbis Volume XV 2 (Summer 1971), p. 511.

has grown up, based not on a once-and-for-all dose of technology but for which a continuous stream of new products and processes is necessary in order to penetrate deep into the market".² Science-based industries included aircraft, electronics, drugs, electrical machinery, chemicals and instruments. In the introduction to the report, the authors stressed that

the comparisons made on the basis of the statistics contained in the report are of an experimental nature The report is being published in the hope that it will stimulate a critical examination of the subject and will open up the way to improving the methods and statistics used.³

Despite this request for caution, a diverse wave of books and articles that contemplated the issues set out in the report were published in Europe and in the United States. The authors of this literature came from a variety of backgrounds including economics, business, political science and journalism; however, a common feature of this literature was that it expressed concern about an American lead over Western Europe in the development and implementation of new technology.

European authors argued that a dramatic increase in direct US investment in Western Europe, large U.S. government expenditures on research and development, and U.S. government procurement policies resulted in an advantage for U.S. firms in the

²Organization for Economic Co-operation and Development (OECD). Gaps in Technology; Comparisons between Member Countries in Education, Research and Development, Technological Innovation; International Economic Exchanges. (Paris, 1970), p. 135.

³ C. Freeman and A. Young, The Research and Development Effort in Western Europe, North America and the Soviet Union, (OECD, 1965), p. 5.

international economy and caused what they termed a 'technology gap' between the United States and Western Europe. American politicians and economists, on the other hand, argued that the 'gap' between the U.S. and Western Europe was a 'cultural gap' resulting from rigid social structures and hierarchical educational systems in Western Europe. In their view, only reform of the traditional social structure would allow Western Europe to compete effectively with the United States in the development and production of new technology. The purpose of this chapter is to analyze the issues related to both arguments within the context of the evolving computer industry in Western Europe.

The Gap defined:

With the publication of Servan-Schreiber's book, Le Défi Américain in 1967, the 'technology gap' received much publicity and quickly became a subject of great interest in Europe as well as in the United States. In 1969, the Organization for Economic Cooperation and Development (OECD) confirmed the fears outlined in Servan-Schreiber's book with a study that concluded that in specific economic sectors, such as scientific instruments, electronic computers, electronic components, plastics, pharmaceuticals, non-ferrous metals and aircraft, disparities existed between the U.S. and Europe.⁴ According to this report, the 'gap' between the U.S. and Western Europe in developing and producing electronic computers was especially worrisome to Europeans because at the time, the computer sector was believed to be the single most important

⁴ The OECD Report Gaps in Technology consists of several volumes, each of which analyzes an economic sector related to the technology gap.

sector of the economy. As pointed out in the OECD report, Electronic Computers, Gaps in Technology,

[t]he strategic significance of the computer is partly due to the fact that information is the key to management, be it in a private company, a government agency or a branch of the armed forces. The close involvement of the computer with this management function explains to some extent the present concern over the technological gaps in this industry.⁵

Western Europeans did have cause for concern. The most significant aspect of the structure of the computer market was that, as early as 1962, American firms dominated the American as well as the Western European computer market, with the exception of France and Great Britain. By 1962, American firms had installed a total of 7,305 computer systems in the United States.⁶ Of these installations, IBM was responsible for 4,806 or 65.8 percent, while Sperry Rand came distant second with 635 or 8.7 percent of total installations. The remaining 1,764 or 25.5 percent were divided among another fifteen American companies.⁷

In comparison, a total of 1,145 computer systems were installed in 1962 in France, Great Britain and Germany.⁸ In France and Great Britain, national computer firms fared reasonably well. The French firm, *Les Machines Bull* installed 140 systems or 49.1 percent compared with IBM, which accounted for 139 or 48.8 percent of a total of

⁵Organization for Economic Co-operation and Development (OECD), Electronic Computers, Gaps in Technology (Paris, 1969), pp. 26-27.

⁶ OECD Electronic Computers, p. 159.

⁷ OECD Electronic Computers, p. 159.

⁸ OECD Electronic Computers, p. 160 - 162.

285 installed systems.⁹ In Great Britain, ICL, a national computer firm, was firmly in the lead with 159 or 51 percent of installations, while IBM accounted for only 56 or 17.9 percent of the total number of computers installed in 1962.¹⁰ In Western Europe IBM was most successful in West Germany, where it installed 341 of a total of 548 systems or 62.2 percent by 1962. In comparison, Zuse, KG, a national firm, came second with 64 installations or 11.7 percent, while the West German firm Siemens was in third place with only 4.7 percent.

These numbers show that as early as 1962, IBM held a sizable share of the computer market in the US as well as in Western Europe, thus making it difficult for any firm, Western European or American, to make inroads into this market. This lead threatened to become even larger when on, 7 April 1964, IBM announced its System/360, which ushered in a new era in computer design.¹¹ The System/360 product line consisted of a family of interchangeable computers of various sizes, supplemented by forty-four peripheral devices, magnetic storage devices, visual display units, communication equipment, card readers, punches, printers and an optical reader.¹² Martin Campbell-

⁹ OECD Electronic Computers, p. 160

¹⁰ OECD Electronic Computers, p. 162.

¹¹ Katherine Davis Fishman, The Computer Establishment, p. 99.

¹² Martin Campbell-Kelly and William Aspray, Computer; A History of the Information Machine (New York : Basic Books, 1996), p. 277. Although System/360 is hailed as the first, third generation system, its Central Processing Unit (CPU) incorporated Solid Logic Technology, a hybrid technology that was about half-way between transistors and integrated circuits.

Kelly, author of ICL: A Business and Technical History, points out that "System/360 produced two major competitive challenges to other manufacturers: first, the concept of a compatible range, and second, several-fold increase in price/performance over existing computers."¹³ The System/360 series marked the beginning of a technological revolution, and IBM's competitors were well aware of it. To Western European computer firms, the challenge appeared virtually insurmountable.

In technological terms, Western European firms now lagged an entire generation behind IBM. In 1963, the French firm, *Les Machines Bull*, announced its Gamma 10, a second-generation business computer that was delivered in 1964, the same year as IBM announced its third-generation System/360. In the same year, Siemens, the largest West German computer firm, delivered its first data processing system 3003 and the process computer 3003P, both of which were second-generation computers.

The advent of System/360 left three possible strategies for competitors of IBM. The first was to produce a compatible system, but beat IBM in terms of price. The second was to produce a non-IBM compatible range of computers, while a third strategy was to find a niche that was not served by IBM.¹⁴ Following the announcement of System/360, the Western European computer market became a battleground for dominance as American competitors of IBM expanded into the European market by

¹³ Martin Campbell Kelly, ICL; A Business and Technical History (Oxford: Clarendon Press, 1989), p. 229-230. See also Aspray and Campbell-Kelly, Computer; A History of the Information Machine.

¹⁴ Martin Campbell-Kelly and William Aspray, Computer; A History of the Information Machine, pp.145-146.

buying sizable shares of existing European firms or by establishing subsidiaries in Western Europe.

Direct American Investment:

With the increased presence of American firms in Western Europe, a debate over the effects of direct foreign investment took on increased importance in the mid-1960s.¹⁵ Direct investment made it possible for American firms to by-pass the common tariff barrier that was being implemented by the EEC.

American firms placed their investment in two ways. Some firms set up manufacturing subsidiaries in European countries. For example, by 1970 IBM had ten subsidiaries in Western Europe, each of which was involved in a different aspect of the production of computers. Another option was the purchase of substantial shares of existing European firms. An example for this type of direct investment was the purchase of a 50 percent share of the French computer firm *Machines Bull* and the Italian firm *Olivetti* by General Electric in 1964. Both types of investment, it was argued, gave considerable economic control to U.S. firms and, indirectly, to the US government.

The history of U.S. direct investment in Europe reaches back to the late nineteenth century. American companies such as General Electric, Standard Oil, National Cash

¹⁵ The implications of direct foreign investment became a concern in several other countries as well at this time. Literature on this subject relating to Canada - US relations is substantial. J.-J. Servan-Schreiber explores these issues from a French perspective in his book the American Challenge. Rainer Hellmann, Amerika auf dem Europa Markt, US Direktinvestitionen im Gemeinsamen Markt, (Baden-Baden: Nomos Verlagsgesellschaft, 1966), explores these issues in relation to the Common Market Countries.

Register and IBM (Dehomag) were established in Europe in that period.¹⁶ What was significant, however, was that after World-War II, and specifically in the years from 1957 to 1965 (the period during which the EEC's common tariff barrier was established), U.S. direct investment in Europe more than tripled from \$4,151 million to \$13,894.¹⁷ According to Robert Gilpin, 1,900 American corporations had established subsidiaries or acquired substantial shares in European owned firms by 1965.¹⁸ Initially, Europeans welcomed American direct investment because it solved the capital shortages that hindered economic recovery after World War II. However, by the mid-1960s, American direct investment was perceived as a threat to the economic and political independence of Western Europe. The negotiations of the Kennedy Round General Agreement on Tariffs and Trade (GATT), that was intended to liberate tariffs, as well as the political implications of the Vietnam conflict, caused considerable anxiety among Western Europeans about the possibility of becoming economically and politically dependent on the U.S.¹⁹

¹⁶Hellmann, Amerika auf dem Europamarkt, p. 23.

¹⁷Christopher Layton, Advanced Technology: A Program for Integration (London: George Allen & Unwin Ltd), 1969 Table 1, p. 271. John Diebold, "Is the Gap Technological?" Foreign Affairs, No. 1 (October 1967), p. 277. Rainer Hellmann Amerika auf dem Europamarkt, p. 214, notes that in 1957, direct investment in the EC countries amounted to \$1.7 billion and had tripled by 1964 to \$5.4 billion.

¹⁸ Robert Gilpin, France in the Age of the Scientific State (Princeton, N.J.: Princeton University Press, 1968), p. 43.

¹⁹ Henry Nau, "A political Interpretation of the Technology Gap Dispute," p. 513; Robert Gilpin, France in the Age of the Scientific State, p. 43.

Opinions on whether American direct investment was an advantage or a disadvantage for Common Market countries varied. One of the arguments put forth was that direct investment obstructed political and economic control by the host government. Y.S. Hu for example, defined foreign investment as “. . . investment in enterprises located in one country but effectively controlled by residents of another country.”²⁰ Charles Kindleberger, Professor of Economics at the Massachusetts Institute of Technology, pointed out that, “[d]irect investment differed from other kinds of international capital movements in that it was accompanied by varying types of control, plus technology and management.”²¹ Hu and Kindleberger’s opinions rested on the notion that foreign direct investment was inextricably linked to foreign political control.

American direct investment was especially heavy in the computer sector of Western Europe as American firms acquired substantial shares of existing firms and/or established subsidiaries. The strategic significance of the computer was partly due to the fact that information was key to management in private companies as well as in government agencies because computers made large quantities of information available in

²⁰Y.S. Hu, The Impact of U.S. Investment in Europe; A Case Study of the Automotive and Computer Industries (New York: Praeger Publishers, 1973), p. 3.

²¹Charles Kindleberger, American Business Abroad, Six Lectures on Direct Investment (New Haven and London: Yale University Press, 1969), p. 3.

any geographical location.²² Servan-Schreiber predicted that the computer would become a central aspect in the functioning of society by the 1980s.²³

Concerning the issue of political control, Robert Gilpin was of the opinion that direct U.S. investment would not result in political control over Western Europe. He stated that with “a few exceptions in the defense-related areas, American firms in Europe have conducted their business independently of the foreign policy of the United States.”²⁴ However, the issue of foreign political control entailed much more than foreign policy. The Report on the Computer Industry in Europe, by the Consultative Assembly of the Council of Europe conveyed the fear of American domination in this specific area. The report stated that,

Total control of the computer industry in Europe might inevitably jeopardize not merely some aspects of an independent foreign policy but place at risk Europe’s freedom of action in a number of important economic spheres - from trade policy towards the Eastern bloc, to the development of other strategic technological industries (such as the nuclear industry).²⁵

Fear of foreign control was at the centre of the debate surrounding the 'technology gap'. French fears of American domination were confirmed when the American

²²Organization for Economic Co-operation and Development. Gaps in Technology Electronic Computers, (Paris, 1969), pp. 26-27.

²³Servan-Schreiber, The American Challenge, pp. 83-89.

²⁴Robert Gilpin, “Of Course the Gap’s Not Really Technological,” Public Interest. Number 12 (Summer 1968), p. 126

²⁵Consultative Assembly of the Council of Europe. Report on the Computer Industry in Europe. Document no. 2839, rapporteur Mr. Ian Lloyd, (Strasbourg, 1971), p. 23.

government put an embargo on the export of large computers between 1963 and 1966. In his article, "Some New Targets Defined for French Science Policy", John Walsh wrote that, "[g]rounds for the embargo were such that computers could abet French nuclear weapons-development, and that delivery should be forbidden under the nondissemination provisions of the Moscow Test Ban Treaty."²⁶ The French government, on the other hand, came to the painful realization of just how dependent it was on American computer technology, and as pointed out in Walsh's article in Science, ". . . the embargo appears to have lent weight to French warnings to other European nations against dependence on the United States for critical materials, high-technology equipment, or technical information."²⁷

Industrialists in Germany also raised concerns about American domination. They were concerned that unless Germany developed a computer industry of its own, it would become dependent on United States' know-how in developing and manufacturing computer technology. A 'Memorandum concerning the situation on R and D in electronic Data Processing systems in Germany', states that " it is necessary for a nation of scientific and technical significance such as the Federal Republic of Germany to conduct its own R and D in the domain of computers."²⁸ While German industrialists may have been

²⁶"France: First the Bomb, Then the Plan Calcul," Science, vol. 156 (12 May 1967): 767.

²⁷ John Walsh, "Some New Targets Defined for French Science Policy," Science vol. 155 (5 May 1967), p. 627.

²⁸ B138/1702. Siemens and Telefunken, "Memorandum zur Lage der Forschung und Entwicklung von elektronischen Datenverarbeitungs-Anlagen in Deutschland". (München/Ulm: 9 Juni 1965), p. 4.

concerned about German independence from American technology, they also used the issues related to the 'technology gap' as an opportunity to solicit government support for R and D in the domain of computers.

Although critics viewed American direct investment as a threat to European independence, others like Professor Walter Hallstein, President of the Commission of the Economic Community, saw it as instrumental in rebuilding Europe after World War II.²⁹ Christopher Layton, Director of the Centre for European Industrial Studies at Bath University, was also of the opinion that direct investment brought substantial economic and political benefits to Western European countries. The most obvious benefit of U.S. direct investment was the transfer of new technology from the U.S. to Europe. Direct investment also benefited Europeans in other ways. In older industries such as steel production, management methods improved and productivity increased after American firms introduced new production processes and materials.³⁰

The host countries provided tax and other incentives to encourage American firms to set up in development districts where, according to Christopher Layton and Sidney Rolfe, “[t]he stimulus has been particularly valuable in backward regions, where the effect of the original investment has spread outwards, bringing idle resources into use.”³¹ More direct benefits resulted from capital investments in subsidiaries which, between

²⁹Speech in Amsterdam, February 4, 1965, quoted in Rainer Hellmann, Amerika auf dem Europamarkt; US Directinvestitionen im Gemeinsamen Markt, p. 20.

³⁰Christopher Layton and Sidney E. Rolfe. “Trans-Atlantic Investments.” in The Atlantic Papers (New York: The Dunellen Company Inc., 1967, 1968, 1970), p. 26.

³¹Layton and Rolfe, “Trans-Atlantic Investments.”, p. 25.

1963 and 1965, consisted of \$6.8 billion invested by U.S. firms in plant and equipment, all of which stimulated economic growth in Europe.³²

While multi-national corporations had existed for quite some time, manufacturing subsidiaries that were controlled by their mother firm were a new phenomenon, and American firms were the first to succeed in this new form of international trade. American firms operated on a transnational level at a time when Western Europeans were just beginning to break down the political boundaries of the nation state that had been the foundation of the European political order until World War II.

French President, Charles de Gaulle, was adamant that France retain its independence and he viewed American direct investment as a threat to that independence. He feared that if France were drawn too close into the American orbit, it would become a mere satellite of the U.S. In de Gaulle's view, the result would be the disappearance of French culture and an Americanization of Europe.³³ As de Gaulle himself pointed out, an essential dimension of national independence was the development of completely independent nuclear power,³⁴ and a national computer industry was vital to achieve that goal. By 1964, many Western European politicians and industrialists of diverse political stripes shared de Gaulle's sentiments.

³²Layton and Rolfe, "Trans-Atlantic Investments.", p. 24-25.

³³ Alain Peyrefitte, C'etait de Gaulle (France: Édition de Fallois, Fayard, 1999), p. 42.

³⁴ Peyrefitte, C'etait de Gaulle, p. 42.

The Gap in Research and Development:

Closely related to the issues on direct foreign investment was American government support for R and D. The OECD report, The Research and Development Effort in Western Europe, North America and the Soviet Union, compared the research efforts of Western Europe, the United States and the USSR based on 1963 data. In the introduction to the report the authors stated that "At official exchange rates the USA spent about four times as much on research and development as Western Europe" ³⁵ (See Table 1) Freeman and Young pointed out that there were differences in research costs that made it necessary to apply a "research exchange rate" in order to make more effective comparisons. To determine the benefits of R and D to private industry, Freeman and Young distinguished between civilian research and military and space research. They noted that

About 60% of the American expenditure was for military and space research compared with about 33% in Western Europe. Thus the United States lead in military and space research was very great - it was of the order of 7 to 1 at official exchange rates or 4 to 1 at a "research" rate. But taking civil research alone the United States lead is much less - about 2 1/2 to 1 at official rates or 1 1/2 to 1 at a "research rate". ³⁶

Table 1 shows that for 1963-64 the U.S. government funded a total of \$13,398 million (63.5 percent) of total U.S. R and D compared to an average of \$2,550 million (59.2 percent) in the UK, France and Germany combined. In the same period, the U.S.

³⁵C. Freeman and A. Young, The Research and Development Effort in Western Europe, North America and the Soviet Union, (OECD, 1965), p. 11.

³⁶ C. Freeman and A. Young, The Research and Development Effort in Western Europe, North America and the Soviet Union, p. 11.

government spent \$11,823 million (53.3 percent) on space, defense and nuclear R and D. In comparison, government support for space, defense and nuclear R and D comprised \$804 million (40.2 percent of Gross National Expenditure on R and D (GERD)) in the UK, (\$635 million (43.4 percent of GERD) in France and only \$238.5 million (15.9 percent of GERD) in Germany. Absolute values indicate that in the area of defence, space and nuclear projects, the gap in R and D between the United States and Western Europe was quite large.

Since such a large amount of R and D funds in the U.S., Great Britain and France went to defense, space and nuclear projects, it is important to understand the relationship between government sponsored R and D for defence purposes and the benefits to private industry. Opinions on this issue were (and still are) divided. At the time, Richard H. Kaufman and others argued that government support for military and space R and D was of relative little significance to private industry for several reasons.³⁷ First, there could be little communication among institutions and scientists considering the strict security

³⁷For further information regarding additional points opposing the view that defense sponsored R & D benefited private industry see Richard H. Kaufman's paper, "Technology and the Atlantic Community," pp. 67-68. See also Theodore Levitt, "The Gap Is Not Technological", p.119-124.

Table 1: R and D Funding³⁸

	Country	Government-funded R&D 1963/64										Non Gov't- funded R&D 1963/ 64		Total	
		Space		Defence		Nuclear		Other		Total		%	\$M (US)	%	\$M (US)
		%	\$M (US)	%	\$M (US)	%	\$M (US)	%	\$M (US)	%	\$M (US)				
1	U.S.	19.9	4,198	30.5	6,435	5.9	1,244	7.2	1,519	63.5	13,398	36.5	7,701	100	21,100
2	U.K.	0	0	33.1	662	7.1	142	14.4	288	54.6	1,092	45.4	908	100	2,000
3	France	1.7	25.5	20.0	300	21.7	325.5	19.7	295.5	63.1	946.5	36.9	553.5	100	1,500
4	Germany	0.7	10.5	7.8	117	7.4	111	25.1	376.5	41	615	59	885	100	1,500
5	U.K + France + Germany (% is average)	1.2	36	20.3	1,079	12.1	578.5	19.7	960	52.9	2,653.5	47.1	2,346.5	100	5,000

³⁸ OECD, Gaps in Technology: Comparisons between Member Countries in Education, Research and Development, Technological Innovation, International Economic Exchanges (OECD: Paris, 1970), pp. 120 & 123 and my own calculations.

that was often imposed within the defense sector. Second, government sponsored research and development may actually have resulted in a drain of scientists away from private industry, thus having an adverse impact. To support this argument, Kaufman cited an OECD study on U.S. science policy that found that “. . .most federal research funds go to industries that contribute only a small share of the economy’s total GNP.”³⁹ In addition, Kaufman pointed to Robert A. Solo’s argument that the transfer of technology from the defense sector to the consumer sector often required additional funds, although the initial development of computers was stimulated by the defense sector.⁴⁰ According to Kaufman, the tremendous success of the American computer industry should not be attributed to government defense spending. However, this view is now universally disputed by historians of computing.⁴¹

In contrast, the OECD report, Gaps in Technology, comparisons between member countries . . ., published in 1970, noted that,

It is not a matter of measuring spin-off but of identifying activities, which might be susceptible to spin-off. The evidence presented for the United States report, "Policy Planning for Technology Transfer" suggested the importance of "intangible" rather than "tangible" spin-off, that is, the use of generated knowledge for civilian purposes rather than the simple adaptation of military or space hardware for the civilian market⁴²

³⁹Kaufman, “Technology and the Atlantic Community”, p. 67.

⁴⁰Robert A. Solo, “Gearing Military R&D to Economic Growth,” Harvard Business Review (November/December, 1962), in Kaufman, “Technology and the Atlantic Community,” p. 67.

⁴¹ Kenneth Flamm, Creating the Computer; Government, Industry and High Technology, pp. 29-79. Martin Campbell Kelly, ICL, A Business and Technical History, (Oxford: Clarendon Press, 1989).

⁴² OECD, Gaps in Technology; Comparisons between Member Countries, p. 132.

The correlation between R and D funds and the success of American computer firms in particular is difficult to establish. As pointed out in the OECD report, Gaps in Technology, Electronic Computers, “ it was not possible to get clear statistical evidence as to whether significant commercial benefits were derived from the large sums spent on the development of defense technology.”⁴³ Christopher Layton, however, suggested that government support was fundamental to the success of US electronics companies. While he agreed that there was a classified barrier keeping vital information secret, his opinion was that inside this barrier ideas moved freely between defence companies, universities and government. He also pointed to the fact that there was movement of personnel between these sectors effectively transmitting skills and ideas from the space, defence and nuclear sectors and the universities to private industry.

Christopher Layton agreed that the Americans could have increased economic productivity in more effective ways, but he was of the opinion that government support for R and D had a Keynesian effect in that it stimulated knowledge in other industries. Layton pointed out that it was in those fields where the American Government has provided this huge incentive that a 'technology gap' between the US and Europe existed.⁴⁴ In fact, one might take this argument even further by pointing out that IBM, which received one of the largest shares of US government support for R and D, became the most successful US firm in developing and manufacturing computers. IBM's biggest

⁴³OECD, Electronic Computers, p. 133.

⁴⁴Layton, European Advanced Technology, p. 49.

computer project was, without a doubt, awarded within the framework of the SAGE System, an early warning system for the Air Force. Estimates of the cost for this project ranged between \$4 and \$12 billion over ten years.⁴⁵ SAGE was also important in that it provided a foundation and experience for future technological development by IBM. IBM was not the only American computer firm reaping the benefits of government contracts associated with the SAGE system and other technological developments fostered by the U.S. Government. Other firms like Burroughs and AT&T also received R & D contracts. What is important is that these firms benefited tremendously in financial and technological terms.

The European computer industry benefited to a much lesser extent from government sponsored R and D than its American counterpart. In absolute value, R and D funds in Europe amounted to only a quarter of those allocated by the U.S. government and they comprised a smaller proportion of the national income in European countries.⁴⁶ As in the U.S., the defence industry in Great Britain and France, was a major recipient of government funded R and D. Table 1 shows that in Great Britain, for example, defense related R and D comprised \$662 million, about one-third of the total R and D budget in 1963/64. France focused its efforts on both nuclear programs and defense programs. In 1963/64, it spent 20 percent (\$300 million) of GERD on space R and D and 21.7 percent (\$325.5) million on nuclear R and D. The defence sector in the Federal Republic of

⁴⁵Kenneth Flamm, Creating the Computer, (Washington: The Brookings Institution, 1988), p. 84.

⁴⁶Layton, European Advanced Technology, p. 50.

Germany was relatively weak with \$117 million of its Gross National Expenditures.⁴⁷ In comparison, the United States government used \$11,877 million of GERD to support R and D, while Great Britain, France and Germany spent \$1,092 million, \$946.5 and \$615 million of GERD respectively.

The OECD report Comparisons between Member Countries, combined with the OECD report Gaps in Technology, left little doubt that, in the area of R and D, American firms enjoyed a considerable advantage over Western European firms. In addition to financial assistance for R and D, the U.S. government provided about half the market for electronic equipment in 1967; more than the entire European market.⁴⁸ In the context of an international market this proved to be of great benefit to American computer firms vis-à-vis Western European firms because a large portion of their expenses were covered by government support.

This Issue of Size:

Western Europeans also viewed the size of American firms vis-à-vis European firms to be an advantage for American firms that operated in Western Europe. Until late in the 19th century, independent inventors dominated the innovation process. However, with the growing importance of science based industries, in the 20th century, in particular the aircraft, chemical, electrical and electronics industries, industrial research conducted in large firms displaced independent inventors and small firms in the innovation process

⁴⁷ OECD, Comparisons between member countries, p. 123.

⁴⁸Layton, European Advanced Technology, p. 33.

in part, because increasingly large investments were required to carry out projects. The writings of the economist Joseph Schumpeter are a perfect example of this change.

While his earlier works stressed the importance of independent inventors, in his book,

Capitalism, Socialism and Democracy, published in 1942, he wrote that

the large scale establishment or unit of control - has come to be the most powerful engine of (economic) progress and in particular of the long-run expansion of total output not only in spite of, but to a considerable extent through this strategy (of monopolistic practices) which looks so restrictive when viewed in the individual case and from the individual point of time.

⁴⁹

In 1952, J.K. Galbraith confirmed this view when he wrote that

Technical development has long since become the preserve of the scientist and engineer. . . . Because the development is costly, it follows that it can be carried on only by a firm that has the resources associated with considerable size.⁵⁰

In 1958, John Jewkes, David Sawers and Richard Stillerman published their book The Sources of Invention, in which they presented a number of individual case studies to stress the continuing role of the individual inventor.⁵¹ It should be noted, however, that Jewkes, Sawers and Stillerman studied inventions rather than innovation.⁵² As opposed to invention, innovation includes the commercial application and marketing of a new product. In the domain of computers, the smaller European firms faced a great

⁴⁹ Joseph A. Schumpeter, Capitalism, Socialism and Democracy (New York: Harper & Row, 1950), p. 106.

⁵⁰ J.K. Galbraith, American Capitalism (Boston: Houghton Mifflin, 1956), p. 86.

⁵¹ John Jewkes, David Sawers, and Richard Stillerman, The Sources of Invention 2nd edition (New York: Macmillan, 1969).

⁵² Jewkes, Sawers and Stillerman, The Sources of Invention, p. 29.

disadvantage compared to the American firms. Commercial application and marketing were very capital intensive and European firms lacked the capital needed for commercial application and marketing of computer technology.

Today, economists accept the notion that small firms are proportionally more innovative than large firms. However, in the mid-1960s, proponents of the 'technology gap' in Western Europe widely believed that large firms were more successful in the field of electronic computers than small firms. They argued that one of the major obstacles to effective competition was that Western European firms were too small to effectively compete with their American counterparts in the international market. Servan-Schreiber, for example, wrote that "*Only a deliberate policy of reinforcing our strong points - what demagogues condemn under the vague term of "monopolies" - will allow us to escape relative underdevelopment.*"⁵³ Robert Gilpin agreed that "in the realm of sophisticated technology the big company with a large R and D budget does most often predominate."⁵⁴ In addition to a sizable R and D budget, large American firms also had the capital resources for extensive advertising, the ability to purchase patents and to acquire entire companies.

Statistics presented in the OECD report, Gaps in Technology; Comparisons between Member Countries, which contains data on R and D by firm size for eight OECD

⁵³ Author's italics. Servan-Schreiber, The American Challenge, p. 159.

⁵⁴ Gilpin, France in the Age of the Scientific State, p. 66.

countries, confirmed that R and D was indeed concentrated in large firms.⁵⁵ However, this conclusion was based on statistical data only and did not take into consideration qualitative aspects that would contribute to the efficiency of a firm in innovating new products. The report broke down R and D by industrial sector and size of firms, but did not discount the importance of small and medium sized firms. According to the report, R and D was concentrated in large firms industry wide; however, the largest concentration was in the electrical (including electronics) and aircraft sectors (Refer to Table 2).

It is difficult to establish a correlation between the size of a firm and its success, but given the evidence available at the time, Western Europeans were of the opinion that in the science based industries, the size of a firm was of paramount importance. True, smaller firms, such as the German firm Nixdorf had been successful in penetrating the computer market; however, they did so by serving small niches that were not served by IBM. Smaller firms had also a greater chance for success in the components industry where the outlay for R and D was not too large. However, the development of larger or more comprehensive systems, such as for example the System/360, required a huge investment and for most small firms the risk was too great.

A number of recent studies on the relationship between the size of a firm and innovation confirm that advantages and disadvantages in the market place exist for both large and small firms.⁵⁶ Although small firms may be significant contributors to innovation,

⁵⁵ Firm size was defined according to the number of employees. OECD, Gaps in Technology: Comparisons Between Member Countries, pp. 147 - 159.

⁵⁶ These studies include, but are not limited to: Nancy S. Dorfman, Innovation and Market Structure; Lessons from the Computer and Semiconductor Industries (Cambridge,

depending on the sector in which the firms operate, in the so-called science-based industries, such as the electronics and aircraft sectors where projects required large investments in R and D, the resources of a large firm were often required in order to bring a product to market.

TABLE 2: Research and Development in Companies with total employment of 5,000 or more:⁵⁷

	United States 1963/64		France 1964		Great Britain 1964/65	
	Expenditure %	Firms %	Expenditure %	Firms %	Expenditure %	Firms %
Chemical	76		72		89	
Machinery	77		41		80	
Electrical	88		55		92	
Aircraft	93		80		100	
Total Industry	81	3	63	12	92	27

*No data is available for Germany.

The Brain-Drain:

An additional symptom of the 'technology gap', the brain-drain, was the movement of European professionals, engineers and scientists to the United States. It was in the science-based industries in particular that Western Europe was lagging behind the United States, and the loss of research potential due to the migration of scientists and engineers to the United States was perceived as a grave problem by Western Europeans. At the same time, the 'brain- drain' carried with it an economic cost since the costs of

Massachusetts: Ballinger Publishing Company, 1987); Roy Rothwell and Walter Zegveld, Industrial Innovation and Public Policy; Preparing for the 1980s and the 1990s (London: Francis Printer (Publishers) Ltd., 1981); Christopher Freeman, The Economics of Industrial Innovation, 2nd Edition, (Cambridge, Massachusetts: The MIT Press, 1982).

⁵⁷ OECD, Comparisons Between Member Countries, p. 155

education and training were borne by Western European nations, but the benefits were reaped by the United States. More important, as scientists and engineers migrated to the US the result was also a loss of future R and D potential for Western Europe.⁵⁸

One way to gain a perspective on the seriousness of the problem of the 'brain drain' is to determine how many professionals, scientists and engineers left for the United States between 1956 and 1965. However, this is a difficult undertaking because the primary sources consulted used a variety of criteria and time frames to capture the 'brain drain' in statistical terms. In his book, France in the Age of the Scientific State, Robert Gilpin pointed out that between 1956 and 1963, 1,500 scientists and engineers migrated from Europe to the United States. In his article, "Is the Gap Technological?" John Diebold estimated that

"[d]uring 1962 through 1966 more than 60,000 professionals and technical workers came from Europe to the United States. The yearly average has remained fairly steady, between 11,000 and 13,000. Among certain professions, up to 15 or 20 percent of those graduated annually from European universities are emigrating, and often they are the best in their field."⁵⁹

According to Christopher Layton, from July 1965 to June 1966 a total of 30,000 professionals and technical brains emigrated to the US. Seventy percent came from Europe, Japan, Canada, Australia and New Zealand.⁶⁰ Given the diversity of this data it is very difficult to put the 'brain-drain' into perspective.

⁵⁸ Christopher Layton, Advanced Technology, p. 18.

⁵⁹ John Diebold, "Is the Gap Technological?", p. 287.

⁶⁰ Christopher Layton, Advanced Technology, p. 17.

The OECD report, Gaps in Technology; Comparison between Member Countries, is likely the most extensive and reliable contemporary source that examined the extent of the 'brain drain' from Western Europe to the United States. The report contains data on emigration from a number of OECD countries into the United States that was collected from numerous national sources. Table 3 shows that in the three Western European countries under examination, the absolute numbers of emigrants were considerable. The data also reveal that the proportion of higher level workers leaving for the United States was greater than the proportion of the labour force or recent graduates in Western Europe. The report states that these proportions ". . . may explain to some extent the apprehensions concerning the phenomenon of the brain-drain in some European countries."⁶¹

Table 3:

"Proportion of Immigrants into the United States in Major Group 0 and in the Occupation Scientists and Engineers by Country of last Residence"⁶²

Last Country of Residence	Active Immigration Population (million)	Major Group (0)* (%)	Scientists and Engineers (%)	Major Group in 1960-61 Stock (%)	Graduation Rate (%)	Graduation Rate in Science and Technology (%)
Germany	10,953	18.4	3.4	7.7	5.5	2.2
France	1,894	23.2	5.4	9.8	7.0	3.2
United Kingdom	15,771	26.8	6.0	8.5	11.8	5.0

*Professional, Technical and related workers.

⁶¹ OECD, A Comparison Between Member Countries, p. 60.

⁶² From Gaps in Technology, A Comparison Between Member Countries, p. 59.

However, statistics do not tell the entire story. One also needs to understand why Western European high level workers emigrated to the US. One reason was that given the expansion of R and D in the 1960s, the US offered many more opportunities to scientists and engineers as well as to professional, technical and related workers.

While it is very difficult, perhaps even impossible to say with absolute certainty how many Western European scientists and professionals migrated to the United States, the fact that Western Europeans perceived that they were losing a significant portion of their skilled labour force to the US was the most important aspect of the brain drain. In West Germany, the 'brain drain' became an important issue because officials feared that the labour shortage would significantly hamper economic growth⁶³ and put the country at an even greater disadvantage vis-à-vis the United States.

The Management Gap:

While Western Europeans blamed the 'brain drain' at least partially for their labour shortage, American scholars and economists argued that Western Europeans lacked an educated labour force to meet the challenges of the new post-war economy. Servan-Schreiber, for example, points out that,

[t]he growing “technology gap” between America and Europe is due primarily to a paucity of higher education, and thus to a relative weakness of science and research. But it is also due to an apparent inability - stemming from a refusal to make an investment, which is precisely the word, in man - to grasp and vigorously apply *modern methods of management*.⁶⁴

⁶³ Documents for Discussion with the Departments regarding the support of Data Processing, (Bad Godesberg, Oktober, 1965), p. 2.

⁶⁴ Servan-Schreiber, The American Challenge, p. 75.

Servan-Schreiber used as evidence statistics that point to the fact that in Europe fewer people enjoy the benefits of higher education. He notes that in 1966, forty-three 43 percent of the people between 20 and 24 in the U.S. were enrolled in colleges and universities, compared to only 16 percent in France, 7 percent in Britain, and 7.5 percent in Germany.⁶⁵

In his 1964 study of the origins of American economic expansion, Edward F. Denison concluded that education is a very important factor in the increase of productivity.⁶⁶ In traditional industries capital, labour and land are the main inputs to economic growth, and until World War II, growth and reinvestment of capital was perceived as a key factor in economic growth as a whole. With the growing importance of science-based industries after World War II, education of the labour force, among other things, became an important factor in economic growth. American economists and policy makers argued that what Western Europeans called the 'technology gap' between Europe and United States was actually a management gap that was caused by a lack of education of the labour force.⁶⁷

Education of the labour force can be measured in several ways. One way is to determine the proportion of the population enrolled in primary and secondary schools as well as universities. Table 4 shows the percentage of enrolment for the total population

⁶⁵Servan-Schreiber, The American Challenge, p. 73.

⁶⁶Servan-Schreiber, The American Challenge, p. 70-71.

⁶⁷ Edward F. Denison Assisted by Jean-Pierre Poullier, Why Growth Rates Differ. Postwar Experience in Nine Western Countries, (Washington, D.C.: The Brookings Institution, 1967), pp. 78 - 108.

in the United States, France, Germany and the United Kingdom. It is interesting to note that of the four countries, Germany posts the lowest enrollment in both secondary and higher education. This may be due to the fact that the education system focuses on apprenticeships rather than secondary and university education.

One of the reasons for the lack of management skills among Europeans was that, in general, management education was in low regard.⁶⁸ Servan-Schreiber, Christopher Layton and others were of the opinion that Europeans lagged behind in the electronics sector

Table 4: Enrolments as percentage of *total* population:⁶⁹

Country	Pre-Primary and primary (%)	Secondary (%)	Higher (%)
US	16.6	8.3	2.4
France	15.3	6.4	0.8
Germany	11.1	2.9	0.7
UK	9.8	6.9	0.4

because they failed to train a labour force able to meet the challenge posed by the new economy. What Europeans needed were skilled managers and technicians. To train this labour force, Europeans would have had to reform their education system and allow a much broader section of their societies access to higher education in order to create the human capital needed to feed the new economy.

In addition to the inability of Western European industry to compete with

⁶⁸Kaufman, The Technology Gap, p. 75.

⁶⁹ Adapted from Gaps in Technology, A Comparison Between Member Countries, pp. 34 & 36.

American firms, the archaic educational structures of the European states did little to alleviate the situation. Although a thorough evaluation of the European university system is beyond the scope of this thesis, a brief overview is essential to the understanding of the European economic position vis-à-vis the United States. The structure within the universities reflected the hierarchical social structure of European society. Based on the model of the German universities of the nineteenth century, it had changed only marginally by the 1960s. Within the European university, each discipline is represented by only one professor: the chair. As pointed out by Joseph Ben-David and Awraham Zloczower, “[t]he unity of teaching and

Table 5: "Number of Persons Enrolled in Higher Education as a Percentage of the Age Group 20-24 and Number of Persons Graduating in Relation to Relevant Population"⁷⁰

	Enrolment Rate %		Graduation Rate %	
	University	Total Higher ¹	University	Total Higher ¹
United States	32.7	38.2	20.9	20.9
France	13.4	15.6	5.1	7.0
Germany	5.7	8.3	2.8	5.9
United Kingdom	5.4	11.4	4.8	10.5

¹Including Post-Secondary Non-University.

research broke down when the academic scientist was forced to specialize in the *Institut* in research that threatened to isolate him from the main discipline which he had to teach

⁷⁰From OECD, A Comparison Between Member Countries, p. 36.

if he wanted to become a full professor.”⁷¹ Based on this model, research could be conducted only in the *Institut* and only by the professor. Professors were assisted by *Privatdozenten* (lecturers/researchers) who would work under the professor within a given department.⁷²

Not only did the chair system prevent the possibility for competition among professors at the university, it also prevented the flow of ideas between different departments as well as within the department itself. The system was extremely rigid and allowed for little mobility within any given department unless the professor retired or accepted a position at another university. *Privatdozenten* were often, as a result, denied the opportunity to ever achieve professorial status.

The chair system at the European universities reflected the functions of a hundred years ago when universities were intended to educate a small elite. By the 1960s this function had changed in some countries (most notably the U.S.) and as much as 25-30 percent of the young people were educated at universities. In Great Britain, France and Germany, however, universities have not kept pace with these changes, and in these countries the concept of the university of a hundred years ago was maintained.⁷³ Compared to the European system of higher education, American universities were

⁷¹Joseph Ben-David and Awraham Zloczower, “Universities and Academic Systems in Modern Societies,” *European Journal of Sociology* Number 1 (1962), p. 49.

⁷²Ben-David and Zloczower, “Universities and Academic Systems in Modern Societies,” pp. 49-50.

⁷³Ben-David and Zloczower, “Universities and Academic Systems in Modern Societies,” p. 82.

marked by competition among professors within individual departments, all of which provided for a much more innovative and dynamic system as well as cooperation with other institutions of modern society. In the American system, departments were not limited to one professor and numerous assistants to conduct research. Here each professor conducted research himself.

U.S. society functioned on the basis of equal opportunity for all and the general belief was that social status was achieved based on one's own hard work and achievements - in short, the 'American Dream'. The result was a dynamic and competitive social and economic environment in which countless opportunities to better one's economic status existed. Richard Kaufman points out that "[t]he popular American beliefs . . . that anyone can become wealthy through hard work and luck . . . , and that membership in high society depends mainly on occupation all form an attitude that personal progress depends on personal worth, not birth."⁷⁴ True or not, the important aspect is that it was widely believed, and people actually made an effort to achieve status, wealth and power.⁷⁵ The operative word in this system is 'competition' as individuals as well as businesses made every effort to out-do each other. This competitive environment provided a fertile basis for success in developing and marketing new technology.

European society, on the other hand, was defined by traditional institutions, a more rigid social structure and an archaic educational structure as well as prevailing

⁷⁴ Kaufman, The Technology Gap, p. 74.

⁷⁵ Kaufman, The Technology Gap, p. 74.

nationalism. After World War II, the institutional framework in Europe remained very traditional. The social hierarchy, with a governing elite at the top, was still very much in existence. Status was still very much based on birthright and, as a result, there was less social mobility. Higher education remained largely reserved for the privileged classes and, consequently, Western European states failed to tap the potential of the lower classes.

From this point of view, European industry failed to compete against the American computer industry because the former still operated their businesses along traditional lines. Prior to the establishment of the EEC, European companies only had to compete within the confines of national markets, which were protected by tariff barriers from outside competition. Compared to the American firms, which were always searching for ways to improve management and production, tradition-bound European firms were at a disadvantage. Once the tariff barriers between the six member states of the EEC were removed, European firms lacked the know-how to compete effectively with the American firms. Prior to World War II, governments protected national industries by means of tariff barriers. The establishment of the EEC eliminated tariff barriers between the member states and, in addition, the Kennedy Round of GATT proposed that tariff barriers between the twenty-three countries that signed the initial agreement should be reduced to zero.

Conclusion:

This chapter has explored the symptoms and the possible roots of the technology gap between Western Europe and the United States. European policy makers, academics

and industrialists argued that American government support to industry, foreign direct investment, firm size, and the brain drain contributed to the technology gap. In contrast, their American counterparts argued that these aspects were merely symptoms of a much deeper problem. In their view, the archaic social structures of Western European states failed to tap the potential of the lower classes. In addition, European firms lacked management dynamics, which in turn prevented Western European industry from operating at its full potential.

It would be wrong to attribute the technology gap to one particular cause. Instead, the technology gap should be attributed to a combination of the aforementioned factors. Within the context of the computer industry, however, Western European policy makers and industrialists drew the conclusion that the technology gap was a direct result of American government support for R and D and the size of U.S. firms. The following two chapters will explore how the governments of the two countries, West Germany and France, attempted to counter the technology gap by implementing support programs to assist national computer industries in becoming more competitive in the international market.

CHAPTER 3:

The German Response

Introduction:

Representatives of the German data processing industry and German government officials perceived the technology gap as a threat to economic success. They feared that unless Germany developed its own computer technology, it would not only become dependent on American technology, but would also fall behind in the export of more traditional goods such as electronics and heavy machinery. The issues raised by the technology gap in the mid-1960s made German policy makers aware that computer technology had become a key aspect in future economic growth. They also came to realize the importance of R and D in data processing in relation to economic growth, as well as the need for German data processing firms to become more competitive in an increasingly international market. As a result, the German government responded to the technology gap with a "Federal Support Program for Data Processing for Public Purposes," which was intended to increase the efficiency and competitiveness of the German data processing industry in the domestic as well as international markets.

The first German Federal Support Program was future-oriented in that its largest component, over two-thirds of the funding, focused on industrial R and D for future development of computer technology, while support for the education of personnel was a distant second.¹ The structure of the program was influenced by the fact that the two firms

¹ Tom Sommerlatte und Ian Walsh, Die Entwicklung der Datenverarbeitung in der Bundesrepublik Deutschland - Programmbewertung der DV-Förderung des BMFT, 1967

that benefited most from government support, Siemens and AEG (Allgemeine Elektrizitäts-gesellschaft) -Telefunken, intended to remain competitors. The dominating ideology of the Social Market Economy, the federal state structure, a change in government at the end of 1966, as well as the efforts of the German government to cope with a recession in the late 1960s also influenced the structure of the program. An analysis of the development and initial implementation of the program reveals that it was initiated and developed from the bottom up. While industry provided the blueprint for the program, government departments provided funding and leadership, and members of the scientific community oversaw the implementation of the program.

The German Data Processing Industry:

Representatives from the German data processing industry attributed the technology gap to a competitive disadvantage that existed between themselves and firms of American, British and French origin. They argued that German data processing firms were at a great disadvantage in the international market place because the governments of the United States, Great Britain and France provided considerable support in the form of research contracts and procurement policies to their respective data processing industries.² The authors of a memorandum sent to German government officials in June 1965 noted that "the foundations for all American computers available on the German

bis 1979, (Wiesbaden: Arthur D. Little International, Inc., 1982), p. 78

²B138/1702. E. Hölzler und W. Nestel "Memorandum zur Lage der Forschung und Entwicklung von elektronischen Datenverarbeitungs-Anlagen in Deutschland." (München/Ulm: Siemens and Telefunken, 9 Juni 1965), p. 9

and international market are in this fashion financed up to 80% by the American Government. . . . In 1964, the French government also decided to introduce far-reaching measures to decrease their dependence on the US and England".³ Representatives of the German data processing industry pointed out that they received little or no assistance from the government and, as a result, it had become increasingly difficult to compete in an international environment.

Initially, Germany had a small lead over the United States in the development of computer technology. Although few people outside of Germany are aware of it, in 1941 Konrad Zuse, a German inventor, completed the first electromechanical computer, the Z3, which was the first operational programmable calculator.⁴ However, the development of computer technology in Germany was interrupted by World War II.

After the war, the German data processing industry was virtually non-existent. When Germany was defeated in 1945, the allies devised the Morgenthau Plan, which was a blueprint to dismantle industry and to reduce the country to an agricultural state.⁵ The Berlin blockade of 1948, the occupation of the Eastern zone by the Russians, and a realization of the drastic impact this could have on the entire European economy

³ E. Hölzler und W. Nestel, "Memorandum zur Lage der Forschung und Entwicklung", p. 9.

⁴ Hartmut Petzold, Rechnende Maschinen. Eine historische Untersuchung ihrer Herstellung und Anwendung vom Kaiserreich bis zur Bundesrepublik, (Düsseldorf: VDI-Verlag GmbH, 1985), p. 313. Heinz Janish, 30 Jahre Siemens Datenverarbeitung; Geschichte des Bereichs Datenverarbeitung, 1954-1984, (Siemens Aktiengesellschaft, 1988), p. 17. Electronic Computers; Gaps in Technology, (OECD, Paris, 1969), p. 34.

⁵ Hans-Joachim Braun, The German Economy in the Twentieth Century, (London and New York: Routledge, 1990), p. 148.

motivated the Americans and the British to replace the Morgenthau Plan with the "Second Level-of-Industry Plan" in August 1947, which permitted German industry to produce up to 95 percent of its 1936 levels.⁶ However, the Allied Control Committee prohibited German industry from developing electronic equipment such as semiconductors, transistors, electronic tubes, and nuclear and space technology,⁷ which was fundamental to the development of data processing technology. It was not until the mid-1950s, in the wake of the Korean War and Germany's integration into the North Atlantic Treaty Organization (NATO) that it was allowed to have an armaments industry.⁸ The result was that the environment in which the development of computer technology flourished in the United States, did not initially exist in Germany. Furthermore, German industry was pre-occupied with reconstruction and showed little interest in the financial risks involved in developing computer technology. As a result, by the time German data processing firms entered the computer market, American, British and French firms were already well advanced.

Another disadvantage for the German data processing industry was that the two major firms, Siemens & Halske AG⁹ and AEG-Telefunken, were manufacturers of

⁶ Braun, The German Economy in the Twentieth Century, p. 148.

⁷ B138/1702. "Studie über die elektronische Datenverarbeitung", (Bonn: 10 März 1966), p. 9.

⁸ Hartmut Petzold, Moderne Rechenkünstler. Die Industrialisierung der Rechentechnik in Deutschland, (München: Verlag C.H. Beck, 1992), 216.

⁹ Akiengesellschaft

electronics, while the most successful American firm, IBM, was an office equipment firm. One of the reasons for the tremendous success of IBM was that, when it entered the computer industry, its punch card customers proved to be a solid base for data processing equipment. Electronics firms were at a great disadvantage compared to business machine firms because they had to establish a customer base in order to market their data processing systems.¹⁰

In October 1965, German policy makers estimated that the German data processing industry lagged behind U.S. industry by approximately four years in the development of data processing systems.¹¹ Measured in quantitative terms, Germany had only 1,984 installed data processing systems, in July 1965, approximately 7- 8 percent of the number of systems installed in the U.S. Of these, the American firm IBM received 770 orders from German businesses, compared to 55 by Siemens & Halske, 20 by Zuse and only 10 by Telefunken.¹²

The three German firms had only a very minimal share of the German computer market and an even smaller share of the international market. By the mid-1960s, industrial representatives were convinced that the German data processing industry could survive only with the help of government funding. The difficulty was, however, that government support had to be justified within the context of the Social Market

¹⁰ Katherine Davis Fishman, The Computer Establishment, p. 21

¹¹ B138/1702. "Unterlagen für die Gespräche mit den Ressorts über die Förderung der Datenverarbeitung", (Bad Godesberg: 11 Oktober 1965), p. 1.

¹² "Unterlagen für die Gespräche mit den Ressorts über die Förderung der Datenverarbeitung", Anlage 1.

philosophy, the prevailing political ideology in Germany at the time.

The Social Market Economy:

In Germany, the development and implementation of industrial policy was closely linked to the evolution of democratic political institutions under the auspices of the Social Market Economy. The Social Market Economy, as envisioned by Ludwig Erhard, one of its main architects,¹³ was based on neo-liberal theory¹⁴, developed in the 1930s by a group of economists around Professor Walter Eucken of Freiburg University.¹⁵ Gustav Stolper, a German economist, pointed out that, at the same time, but independently, “Professor Alfred Müller-Armack at the University of Münster, later state secretary of the Federal Economics Ministry, sought an organic compromise between the spheres of the government, the markets and the interest groups. For this intermediary position Müller-Armack used the designation of “social market economy” (*soziale Marktwirtschaft*)”¹⁶ Ludwig Erhard adopted this doctrine to denote the direction that German economic and social development would take after World War II.

It is important to recognize that, although the concept of the Social Market

¹³ Erhard was Minister of Economics between 1949 and 1963, Vice Chancellor between 1957 and 1963, and Chancellor of the Federal Republic from 1963 to 1966.

¹⁴ Also known as *ordo-liberal* theory.

¹⁵ Gustav Stolper, Karl Häuser and Knut Borchardt, The German Economy, 1870 to the Present, Transl. Toni Stolper (New York: Harcourt, Brace & World, Inc., 1967), p. 234; Ludwig Erhard, Prosperity through Competition, (London: Thames and Hudson, 1958). For a comprehensive study on the Social Market economy, refer to A.J. Nicholls, Freedom with Responsibility; the Social Market Economy in Germany, 1918-1963, (Oxford: Clarendon Press, 1994), p. 224.

Economy stipulates a free market, that is, a market free from government intervention, the word "social" implies the contrary. Essentially, German Social Market Economy was viewed as a 'third way' of economic and political organization - a socially responsible market economy. The Great Depression of the late 1920s and early 1930s had discredited Adam Smith's concept of the 'invisible hand', while the concept of a planned economy had been discredited by dictatorships in Nazi Germany and Stalinist Russia. Similar to the notion of the British Welfare state, German policy makers sought an alternative or 'middle way' between the two extremes of economic organization. The social market economy was founded on the idea that political liberty depended on economic freedom and that competition was the key to economic prosperity. However, this did not mean government would not intervene at all. Instead, as Gustav Stolper observes, this "newly formulated, economic freedom on the contrary presupposed a very active government, although the government's functions should be confined to combating crises, to safeguarding the currency, and above all, to guarding against private positions of monopoly power."¹⁷ The notion that the government was to ensure an economic climate in which competition flourished made it possible for the government to consider and eventually grant financial support to the data processing industry.

The *Act against the Restraints on Competition* or Cartel Law was implemented in 1957¹⁸ and became the cornerstone of the Social Market Economy. A draft of this anti-

¹⁶ Gustav Stolper, The German Economy, p. 234.

¹⁷ Gustav Stolper, The German Economy, p. 235.

¹⁸ The law was implemented after much pressure from the allies. However, by the time it was introduced, it was watered down considerably. Numerous exceptions existed

trust law had been introduced in 1952; however, strong opposition from industry delayed its implementation. This law prohibited the formation of cartels and other agreements that limited competition. According to Ludwig Erhard, restriction of economic power was necessary to balance the market economy. "In particular", he noted, "there must be guarantees that nothing will hinder the production of free price regulating in a free market which acts as a guide to the trend of the economy."¹⁹ The Federal Cartel Authority (*Bundeskartellamt*) was responsible for ensuring that the law was observed. However, as Hans-Joachim Braun, a German economic historian, notes, industrial concentration in the Federal Republic increased despite the Cartel Law. In this regard, the Federal Support Program for Data Processing contradicted the Cartel Law in that it constituted an interference in the free market by providing a competitive advantage to the two largest West German computer firms.

Federalism:

The structure of the Federal Support Program for Data Processing was influenced only indirectly by the structure of the Federal Republic of Germany because the program was developed at the federal level in partnership with the computer industry.²⁰ Although not always workable, federalism is build on cooperation and consensus among varying interests within a state. At the time, the Federal Republic of Germany (FRG) consisted of

which allowed the formation of a cartel under certain conditions. Gustav Stolper, The German Economy, p. 258. - 261.

¹⁹ Ludwig Erhard, Prosperity through Competition, (London: Thames and Hudson, 1958), p. 127.

²⁰ B138/1703. "Programm für die Förderung der Forschung und Entwicklung auf dem Gebiet der Datenverarbeitung für öffentliche Aufgaben" (Stand: April 1967), p. 34.

the central government and the eleven Länder (states). German federalism varies from other modern federations, such as the United States and Canada, in that the federal government has legislative authority over a number of functions, but the Länder have executive authority.²¹ More than half of all bills passed require the approval of the *Bundesrat*, which proportionally represents the Länder.²² Documentation for the first Federal Support Program for Data Processing indicates that it was developed and implemented at the federal government level and it did not affect policy in the states. However, the architects of the program had to ensure that general agreement and cooperation among all parties involved at the federal level existed in order to get the required legislation approved. The result was a decentralized program that incorporated the needs of several government departments, the scientific community and industry.

The Role of Individual Government Departments:

Limited support for the data processing industry existed prior to the implementation of the Federal Support Program for Data Processing. For example, in 1966, individual federal government departments had DM 9 million available for data processing related projects. Of this total, the Ministry of Defense provided DM 4.7 million for numerous research projects,²³ while the Ministry of Scientific Research set

²¹ Ronal L. Watts, "West German Federalism: Comparative Perspectives" in German Federalism Today, by Charlie Jeffrey and Peter Savigear (New York: St. Martin's Press, 1991), p. 28.

²² Facts about Germany (Frankfurt am Main: Societäts-Druck, 1995), p. 144.

²³ Projects funded by the Ministry of Defense included: pattern recognition (*Mustererkennung*), real-time computing including programming, human-machine

aside DM 2.5 million for projects related to data processing in nuclear research, data processing for the space program and automatic documentation. Several other ministries, which had only small budgets for the support of R and D in data processing, contributed the remaining DM1.8 million.²⁴ At this time, there was no coordination of the efforts among the various departments and by the mid-1960s the data processing industry convinced federal officials that this type of support was too fragmented and too little to make a difference.

In addition to support for R and D from individual government departments, the German Research Society (*Deutsche Forschungsgemeinschaft*, DFG) provided funding for educational institutions to acquire data processing equipment. Established in 1947 as the Emergency Society of German science (*Notgemeinschaft der Deutschen Wissenschaft*) it was renamed the German Research Society in 1949²⁵ and formed the institutional basis for support of scientific research in Germany.²⁶ In the first years of its existence, support from the DFG was limited to the arrangement for research grants, mostly from European Recovery Plan funds, for research projects related to economic

communication, command and control, bionics, adaptive systems, artificial intelligence and machine translation. B138/1702. "Ergebnisniederschrift: 3. Ressortbesprechung über die Förderung und Entwicklung auf dem Gebiet der Datenverarbeitung," (Bad Godesberg: BmwF, 1 August 1966), p. 4.

²⁴B138/1703. "Übersicht über die Ressortforschung auf dem Gebiet der Datenverarbeitung sowie Schwerpunktprogramme "Informationsverarbeitung" und Nachrichtenübertragung" der DFG", Annex B, (26 Juni 1967).

²⁵Hartmut Petzold, *Moderne Rechenkünstler*, p. 236.

²⁶History of the Deutsche Forschungsgemeinschaft (Deutsche Forschungsgemeinschaft, Kennedyallee, 40, 53175 Bonn)
<http://www.dfg.de/english/history.html>.

issues.²⁷ Beginning in 1956, after European Recovery Funds (ERP) dried up, the DFG was funded jointly by the Federal government and the states (*Länder*), with the Federal government providing over half of the annual subsidies.²⁸

The DFG program focussed on the acquisition of data processing systems for scientific purposes. Between 1952 and 1966, the DFG made available DM 179 million to support data processing. Of these funds, DM 88 million were used for the acquisition of fifty-four computer systems for use at colleges, technical universities and research institutes, while only a small amount, approximately DM 21 million, went toward R and D.²⁹ Ironically, most of the systems purchased by the DFG were purchased from American firms, and in particular from IBM.

Although, the focus of DFG support was on providing data processing systems for educational purposes, several German computer firms received limited financial support through the DFG. In 1956, the Ministry of Defence funneled funds through the DFG to provide financial support to the German computer industry. Hartmut Petzold, a well respected German historian of technology and head of the department for computing and

²⁷Gerhard A. Ritter, Grossforschung und Staat in Deutschland, ein historischer Überblick (München: Oskar Beck, 1992), p. 59.

²⁸Klaus H. Goetz, Intergovernmental Relations and State Government discretion: The Case of Science and Technology Policy in Germany (Baden-Baden: Nomos Verlagsgesellschaft, 1992), p. 89.

²⁹B138/1702. "Studie über elektronische Datenverarbeitung" (Bonn: Bundesministerium für Wirtschaft, 10 März 1966), p. 14. There are some inconsistencies in the numbers provided. The study indicates that 88 million DM were made available to purchase fifty-four computers, Sommerlatte und Walsh, Die Entwicklung der Datenverarbeitung, p. 77, indicates that 136 million DM were made available to purchase fifty systems.

automation at the *Deutsches Museum* in Munich, revealed that in the 1956 budget, the DFG received DM 37 million from the newly created Ministry of Defence (Bundesministerium für Verteidigung (BMVtg)) to be distributed for the acquisition of large computers.³⁰ Officials of the Ministry of Defence attached the condition that DM 20 million were to be used to procure computer systems from German firms, even though these systems were not yet ready.

To provide German producers of data processing equipment with much needed capital, half of the purchase price was to be paid in advance.³¹ In 1957, the firm Siemens & Halske received a contract from the DFG to deliver three 2002 computer systems for the Technical School in Aachen, the University of Tübingen and one system that was to be shared by the Technical University of Berlin and the Free University of Berlin.³² Contracts for the development of computer systems also went to Zuse KG, Standard Electronic Lorenz and Telefunken AG.

In early 1966, the DFG implemented the program “Information Processing and Telecommunications Transmission”.³³ The purpose of this particular DFG program was limited to support data processing in colleges and scientific institutes and was intended to provide funding for research into various areas of information processing as well as to

³⁰Hartmut Petzold, Rechnende Maschinen, p. 409; Hartmut Petzold, Moderne Rechenkünstler, p. 236-244.

³¹Hartmut Petzold, Rechnende Maschinen, p. 412.

³²Heinz Janish, 30 Jahre Siemens-Datenverarbeitung, Geschichte des Bereichs Datenverarbeitung, 1954 - 1984 (München: Siemens Aktiengesellschaft, 1988), p. 31.

³³B138/1702 Letter “An den Herrn Bundesminister für wissenschaftliche Forschung” (24 Februar 1966).

ensure an ample supply of new recruits in this innovative technological field. The program allowed for the support of individual research projects at colleges and scientific institutions conducted by individual researchers.³⁴ It should be noted that this support was rather limited when compared to the government contributions in the US, France and Great Britain.³⁵ Nor was it concentrated on industrial R and D. By the mid-1960s it had become obvious that this type of assistance was not sufficient to effectively support the data processing industry in West Germany.

Government Support a Fundamental Aspect of Success:

The initial impetus for a government supported R and D program came from the private sector in March 1964, when representatives from AEG Telefunken and Siemens & Halske contacted the DFG. Several events may have been the basis for this initiative: First, German policy makers may have anticipated IBM's announcement of System/360 in April 1964, which put the German data processing industry on notice that they had to move fast if they wanted to keep pace with technological development.

Second, in November 1964, Siemens & Halske, the largest German data processing firm, entered into a long-term reciprocal agreement with the American firm Radio Corporation of America (RCA), enhancing the notion among industrialists and policy makers that German firms were dependent on American technology.³⁶ Siemens &

³⁴“Übersicht über die Ressortforschung auf dem Gebiet der Datenverarbeitung sowie Schwerpunktprogramme “Informationsverarbeitung und Nachrichtenübertragung” der DFG, Anlage A” (Bad Godesberg: BmwF, 26 Juni 1967), pp. 5 - 9.

³⁵ Refer to Chapter 1, for details.

³⁶ The two firms agreed to an exchange of results of their extensive development

Halske was one of Germany's two major producers of electronic equipment at the time; the other was AEG-Telefunken. However, due to the economic situation and allied restrictions, both firms refrained from participating in the development and manufacture of computers until 1954. According to Heinz Janish, "1954 was the year in which Siemens had rebuilt its factories, laboratories and offices located in the West It was also the year during which Siemens achieved a modest profit of DM 5.5 million."³⁷ On 18 March 1954, the executive committee of Siemens & Halske made the decision to develop and produce computers. The firm developed and produced the 2002, a second generation data processing system. The first of these systems was delivered in 1959.³⁸ In 1960, Siemens began the development of a successor system, the 3003, also a second generation system. The first of these systems was installed in the Dresdener Bank in 1964,³⁹ the year in which IBM announced its System/360.

The partnership between Siemens and RCA gave the former access to the RCA system Spectra 70, which it sold as the system series 4004. Like the IBM System/360, the 4004 consisted of several compatible systems, (except for the two smallest systems). Siemens partially enhanced this system with peripherals from its own production.⁴⁰ As

in the context of a patent and experience exchange and together use their knowledge in the domain of the production, programming and maintenance of systems."

³⁷ Janish, 30 Jahre Datenverarbeitung, p. 25.

³⁸ Janish, 30 Jahre Datenverarbeitung, p. 26.

³⁹ Janish, 30 Jahre Datenverarbeitung, p. 28.

⁴⁰ Janish, 30 Jahre Datenverarbeitung, p. 43 and p. 47 - 49.

indicated in a first draft of the blueprint for the German Data Processing Program, "the technical cooperation has, as expected, resulted in the acceleration of the development and effective expansion of the spectrum."⁴¹ RCA, on the other hand, gained access to the European market.

The third event that motivated representatives of German computer firms to solicit government support was the sale of the German data processing firm Zuse KG to the Swiss firm Brown & Boveri in 1964⁴² because Zuse could no longer afford the tremendous expenses associated with the development of data processing technology. Zuse, KG, which was founded in 1949, was the first to develop and manufacture data processing equipment based on the inventions of its founder Konrad Zuse.⁴³ The firm received its first contract for an electro-mechanical computer from the optical firm *Leitz*, but had little chance against large foreign competitors because the market for this type of machine was saturated by the time Zuse KG had entered it. In a meeting report of April 1968, it was noted that Zuse KG was unable to keep pace with the fast technological development of data processing equipment and at the same time develop an efficient sales organization. According to Minister Rat Gronwald, Ministry of Economics, Brown & Boveri considered selling Zuse to an American firm. Gronwald noted that "in the

⁴¹ B138/3507. "Richtlinien und Programm für die Förderung der Forschung und Entwicklung auf dem Gebiet der Datenverarbeitung für öffentliche Aufgaben," (Stand: 10 Januar 1967), p. 18.

⁴² B138/5544. "Sitzungsbericht", (Bonn: 19 April 1968), p. 2.

⁴³ Programm für die Förderung der Forschung und Entwicklung auf dem Gebiet der Datenverarbeitung für öffentliche Aufgaben, Annex, (Stand: April 1967), p. 6

summer of 1966, the Ministry of Economics tried to awaken the interests of the firms Siemens and AEG - Telefunken so that they would buy or acquire a considerable share in Zuse, in order to prevent the oldest German computer firm from falling into foreign hands, to the detriment of the German economy, and with it the R and D result of the past 25 years."⁴⁴

AEG - Telefunken did not feel it could take on the risk associated with this venture. The firm had started to develop digital technology in 1956⁴⁵, but did not have a large range of data processing systems to offer. The TR 4, the first of which was installed in 1962, was the first system developed by the firm. In addition, AEG - Telefunken developed the medium sized systems TR 5 and TR 10 and, beginning in 1965, it also developed the TR 440, a large general-purpose computer that was compatible with the TR 4.⁴⁶

Siemens remained the only possible purchaser. After extensive negotiations and numerous financial incentives offered by the Ministry of economics, Siemens agreed to purchase a 70 percent share of Zuse effective on 1 January 1967.⁴⁷ Taken together, these three events drove home the notion that unless the German data processing industry was in a position to catch up to American computer industry, Germany would become entirely

⁴⁴ "Sitzungsbericht", (Bonn: 19 April 1968), p. 2.

⁴⁵ Programm für die Förderung der Forschung und Entwicklung, Annex, (Stand: April 1967), p. 1.

⁴⁶ Programm für die Förderung der Forschung und Entwicklung, Annex, (Stand: April 1967), p. 1 - 2.

⁴⁷ "Sitzungsbericht", (Bonn: 19 April 1968), p. 3.

dependent on American technology.

A first meeting between members of the DFG, representatives from industry and officials from two government departments took place on 29 June 1964 at the DFG in Bad Godesberg. Those who were present at this meeting agreed that

. . . although initially in a good position to develop computers in the face of competition from foreign firms, such as for example IBM, German industry will not be able to conduct the large scale development of computer systems without a guaranteed market. On the other hand, . . . German industry cannot forego the development of computer technology if it wants to remain competitive in other areas of the economy. Therefore, the only question that remains is how industry can be assisted financially⁴⁸

It is quite evident, that early on, government officials were in favour of providing financial support to the German data processing industry. However, the challenge was to structure the program so as not to conflict with the precepts of the Social Market Economy.

Following the meeting on 29 June 1964, the Ministry of Defence formed a committee of experts drawn from the Ministry of Defence, the scientific community and industry to conduct an investigation to determine the future need for large computers, to study technical concepts, as well as developmental trends in the application and technology of large computers.⁴⁹ The results of the study were presented in a report in

⁴⁸B138/1702. "*Ergebnis Protokoll*", Betrifft den Bedarf an Datenverarbeitungsanlagen, (Bad Godesberg: BMwF, 29 June 1964), p. 2.

⁴⁹ Dipl.-Math. F. Dörfel, Dr. B. Jessen, Dr. W. Rekowski, Dr. H. Springer und Dr. W. Storz, Gutachten zum Project Grossrechner, (Forschungsinstitut für Funk und Mathematik, Gesellschaft zur Förderung der astrophysischen Forschung e.V., Juni 1965), p. 4.

June 1965. The report concluded that "around the year 1970, the requirement for very large computers in Germany will be sufficient to justify Germany developing its own large computers."⁵⁰

Around the same time, in June 1965, the memorandum titled "*Memorandum zur Lage der Forschung und Entwicklung von elektronischen Datenverarbeitungs-Anlagen in Deutschland*,"⁵¹ was received by the Ministry of Defense and the Ministry of Scientific Research. The authors were W. Nestel and E. Hoelzler from Siemens & Halske and Telefunken respectively. The memorandum outlined the importance of the data processing industry to the German economy as a whole and put forth the argument that government intervention was imperative if the Federal Republic was to retain its status as the world's second largest exporter of electronics.

It was the intention of the authors to convince German policy makers that the data processing industry was essential to the survival of Germany as a strong economic power and that this could be achieved only if the government provided financial support for this sector. They argued that data processing was a significant instrument for rationalizing and increasing economic performance in the private and public spheres.⁵² The "memorandum" to government defined data processing technology as a 'key technology' that was vital for future scientific development. In addition, it outlined the importance of the data processing industry as a building block for other electronic domains, like control

⁵⁰ Dipl.-Math. F. Dörfel, et al, Gutachten zum Project Grossrechner, p. 51.

⁵¹ Translation: "Memorandum regarding the situation of research and development of electronic data processing systems in Germany."

technology (*Regelungstechnik*), which was the foundation for all automated industrial processes⁵³ and as such it was directly linked to rationalizing the economy, increasing profits for industry and assuring wealth and social security for German society as a whole.

The authors pointed out that government support for data processing technology was not just about gaining inroads to new markets, but about retaining Germany's position in the international market.⁵⁴ In this regard, data processing technology was vital for economic progress and innovation even in already existing industrial processes. This aspect was especially important for Germany since it relied primarily on exports and as such was in direct competition for export markets with the United States.

The authors of the memorandum argued that German computer firms were not in a position to benefit from the success this new technology offered because they lacked the capital required for extensive long-term investments in order to become competitive in the development of electronic computers. Given the small market of the Federal Republic and the fierce competition in the international market, German producers of data processing equipment had difficulties turning a profit because the volume of production was not high enough to offset the development costs. "Under these circumstances," the authors wrote,

the responsible authorities should no longer leave the German effort for computer development to the initiatives of firms and the market.

⁵² Sommerlatte und Walsh, Die Entwicklung der Datenverarbeitung, p. 75

⁵³ E. Hölzler und W. Nestel, "Memorandum zur Lage der Forschung und Entwicklung", p. 8.

⁵⁴E. Hölzler und W. Nestel, "Memorandum Memorandum zur Lage der Forschung und Entwicklung," p. 8.

Authorities should, through targeted funding, put the German computer industry in a position to fulfill its tasks in all mentioned domains of science, technology and administration. This should take place through direct assistance of computer development and through the support of the use of German computers in all areas of the public sector.⁵⁵

In other words, given the importance of data processing, the federal government was obliged to assume a leading role in supporting the development of data processing systems in Germany.

The authors continued that

[I]n Germany the three firms Zuse, Siemens & Halske and Telefunken developed computers of their own initiative and based on their own risk without government assistance. . . . Fierce international competition in which government support of the main competitors results in a distortion of prices and in a disadvantage for German firms shows that continuing independent computer development is only possible if the German industry is supported by the state in similar ways.⁵⁶

Industrial representatives pointed to Zuse KG's takeover by Brown & Boveri in 1964 as an example of the difficulties and dangers faced by the German data processing industry. They warned that this could be the fate of all German firms involved in developing computers, unless the government was ready to provide assistance for R and D in the domain of data processing.⁵⁷

In the memorandum, the two firms Siemens & Halske and AEG Telefunken offered to "further expand the development of computers in a study group

⁵⁵E. Hölzler und W. Nestel, "Memorandum Memorandum zur Lage der Forschung und Entwicklung," p. 8 - 9.

⁵⁶E. Hölzler und W. Nestel, "Memorandum Memorandum zur Lage der Forschung und Entwicklung," p. 10.

⁵⁷E. Hölzler und W. Nestel, "Memorandum Memorandum zur Lage der Forschung und Entwicklung," p. 10.

(*Arbeitsgemeinschaft*) and to ensure that German science will make a suitable contribution to this technology.”⁵⁸ However, unlike in the U.S., where Universities were very much involved in R and D, the firms did not want Colleges and Universities to have a leading role in the development of computers for the reason that personnel fluctuations at these institutions would be disadvantageous to the development of computer technology. They recommended that these institutions should assume a partial role only.⁵⁹ This evidence strongly suggests that the two firms put themselves in a position where they would be the major beneficiaries of any financial contribution from the German government.

Preparations for a Federal Support Program for Data Processing:

The Federal Support Program for Data Processing was the first in a series of programs to support the German data processing industry. At the time, federal officials had little or no experience in developing a program of this nature and, as a result, they needed to familiarize themselves with the issues and the technological aspects of data processing systems. It is not the purpose of this analysis to judge the effectiveness of the federal support program, but to analyze and evaluate the steps taken by federal officials in order to develop and implement the program and how the development of the program was shaped by aspects specific to German political structure and culture.

The key ministries involved in promoting and implementing the Federal Support

⁵⁸E. Hölzler und W. Nestel, “Memorandum Memorandum zur Lage der Forschung und Entwicklung,” p. 13. These conditions were set out by government representatives at a meeting in July 1964.

⁵⁹E. Hölzler und W. Nestel, “Memorandum Memorandum zur Lage der Forschung

Program for Data Processing were the Ministry of Scientific *Research* (*Bundesministerium für wissenschaftliche Forschung (BMwF)*) and the Ministry of Defence (*Bundesministerium für Verteidigung (BMVtG)*). The Ministry of Defense was established in 1956, and in the early stages its budget was relatively small when compared to that of the defence departments of other nations. In 1956, it amounted to 4.2 percent of the Gross National Product (7.3 billion DM).⁶⁰ In absolute value, defence spending rose steadily throughout the 1960s to just over 20 billion DM (5.0 percent of GNP) in 1967.⁶¹ Like the defence establishments of other nations, the Ministry of Defence had a special interest in the development of German computer systems because national defence relied heavily on computer technology.

The Ministry of Scientific Research, the other key ministry, was established in 1955 as the Federal Ministry for Nuclear Questions. It was later renamed the Federal Ministry for Nuclear Energy and Water supply. In 1962, the responsibilities of this department were extended and the department was once more renamed; becoming the Ministry of Scientific Research. It coordinated space programs as well as nuclear research programs where data processing systems played an important role, and as one observer pointed out, by the mid-1960s, the Ministry of Defense and the Ministry of Scientific Research were the largest users of data processing systems.⁶²

und Entwicklung," p. 14.

⁶⁰ NATO Facts and Figures, 1971.

⁶¹ NATO Facts and Figures, 1971.

⁶²"Richtlinien und Programm für die Förderung der Forschung und Entwicklung", (Stand: 10 Januar 1967), p. 4.

These two departments supported the development and implementation of a federal support program for data processing from the very beginning. A federal support program meant an increased budget for R and D in data processing, as well as possible spin-off for programs that were already in progress. Consequently these two departments also had the largest budget allocations for R and D in data processing and they agreed that the Ministry of Defence was to fund aspects of the program related to defence technology while the Ministry of Scientific Research funded future oriented projects in data processing technology.⁶³

A first step in developing the program consisted of consensus building. Representatives of the Ministry of Scientific Research consulted with representatives from other departments, the data processing industry and the scientific community. The first inter-ministerial meeting on the issues related to the data processing industry took place on August 9, 1965 and it was attended by representatives of seven government departments. The purpose of the meeting was to determine to what extent other departments, including representatives of the Ministry of Economics (*Bundesministerium für Wirtschaft (BMW)*), favoured direct assistance to the two firms and perhaps also to ensure, that broad-based support for subsidizing the data processing industry existed.⁶⁴

Early on in the process of developing the Federal Support Program for Data

⁶³ "Programm für die Förderung der Forschung und Entwicklung, (Stand: April 1967), p. 9 - 10.

⁶⁴ B138/1702. "Kurzprotokoll der Besprechung über die Förderung der Datenverarbeitung im Bundesministerium für wissenschaftliche Forschung", (9 August 1965).

Processing, policy makers recommended that the necessary investigations to determine whether public support for the data processing industry was feasible should be conducted by an ad-hoc committee comprised of representatives from the DFG (research), industry and government. A recommendation from this committee (*forschungspolitische Vorklärung*) would represent the go-ahead for government support for the computer industry. In Dr. Scheidemann's point of view, "only when a recommendation from this mixed committee is available can the Ministry of Scientific Research count on the agreement of the other ministries, the *Bundestag*, the scientific community and the states (Länder) in its endeavor to support the computer industry."⁶⁵ In short, a recommendation from a mixed committee would legitimize direct government support for R and D and any opposition to the program would be revealed early on and could be dealt with accordingly.⁶⁶

In September 1965, the Ministry of Scientific Research claimed jurisdiction for the Support Program for Data Processing on the basis that it fell within the domain of general research.⁶⁷ In the mid-1950s, the German government had taken a similar approach in relation to R and D in the domains of space and nuclear technology.⁶⁸ To

⁶⁵B138/1702. "Letter to the Minister of Scientific Research" (28 October 1965), p. 2.

⁶⁶ B138/1702 "Vermerk: Betr. Förderung der Datenverarbeitung (DV) durch das BmwF," (16 December 1965).

⁶⁷B138/1702, "Vermerk: Betr.: Förderung der Datenverarbeitung" (30 September 1965), p. 1.

⁶⁸ Peter Fischer, The Origins of the Federal Republic of Germany's Space Policy 1959 - 1965 - European and National Dimensions, (Florence: European University

define future R and D requirements in the domain of data processing, the Ministry of Defence and the Ministry of Scientific Research awarded a contract of DM 300,000 to the two largest data processing firms, Siemens & Halske and AEG-Telefunken, to carry out a detailed study.⁶⁹ The study was to be a list of goals (*Leistungsverzeichnis*) to serve as a norm for future development of data processing equipment.

The study was completed in October 1966 and the two firms recommended a number of research projects.⁷⁰ However, it is important to note that at this time each firm was developing its own distinct data processing system and that the firms intended to remain competitors in the future. As a result, the development of a single data processing system was not an option.

Developing a Federal Support Program for Public Tasks in the Domain of Computers:

The aim of the Federal Program for Data Processing was to improve performance in the domain of technology and system programming of data processing systems. This goal was to be achieved by supporting R and D in the domain of data processing that fulfilled the equipment requirements of several government departments in addition to future oriented development aimed at the 1970s.⁷¹ The basis for the Federal support

Institute).

⁶⁹"Ergebnisniederschrift: Ressortbesprechung über Datenverarbeitung auf dem Gebiet der Datenverarbeitung," (Bad Godesberg: BMWF, 9 February 1966), p. 3.

⁷⁰B138/5539. "Die erforderlichen Forschungs und Entwicklungsarbeiten für ein Datenverarbeitungs- system for öffentliche Aufgaben" (Siemens & Halske und Telefunken, Oktober 1966), p. 155.

⁷¹Refer to: Programm für die Förderung der Forschung und Entwicklung, (Stand:

program was formed by three documents: the June 1965 report, "*Gutachten zum Projekt Grossrechner*"⁷², a study conducted by the Research Institute for Funk and Mathematik with participation from Siemens and Telefunken, "*Die erforderlichen Forschungs und Entwicklungsarbeiten für ein Datenverarbeitungs- system for öffentliche Aufgaben*"⁷³ a study completed by Siemens and Telefunken in October 1966, and the "*Programm für die Förderung der Forschung und Entwicklung auf dem Gebiet der Datenverarbeitung für öffentliche Aufgaben*,"⁷⁴ developed by members of the Ministry of Scientific Research, which was based on the Siemens-Telefunken study, in cooperation with members of an expert committee.

German policy makers were also guided by the success of American data processing firms. The Program for the 'Support of R and D in the Domain of Data Processing' states that "a look into the past shows that the fast development of data processing in the USA was triggered by means of public expenditures, which were given exclusively in view of public demands for data processing."⁷⁵ German policy makers

April 1967).

⁷² Translation: Report about the Project Large Computer. Dipl.-Math. F. Dörfel, et al *Gutachten zum Project Grossrechner*, (Forschungsinstitut für Funk and Mathematik, Gesellschaft zur Förderung der astrophysischen Forschung e.V. (Berlin, June 1965).

⁷³ Translation: Study of the necessary Research and Development for a data processing system for government purposes.

⁷⁴ Translation: Program for the Support of Research and Development in the Domain of Computers for Public Purposes.

⁷⁵ "Richtlinien und Programm für die Förderung der Forschung und Entwicklung," (Stand: January 1967), p. 23.

adapted this model to the German context in that they funded future oriented data processing research projects. They dealt with the limited funds available by confining the program to data processing for government purposes.⁷⁶

The idea to limit the program to support for data processing for government tasks emerged in late 1965 from the completion of the 'Diebold Study' on the status of the European Computer industry, particularly in relation to applications for government tasks and automation.⁷⁷ The study indicated that by 1974, approximately 23 - 24 percent of all data processing systems installed would be used for state purposes and that the expenditures for rental (or purchase) of these systems could be as high as DM 600 million. German government officials realized that the DM 50 million⁷⁸ that was recommended for support of R and D in the domain of data processing was less than 10 percent of the anticipated expenditures for rental (or purchase) of data processing systems by 1974. If, in addition to fundamental research, the government primarily supported R and D that was oriented towards government applications of data processing systems, the savings would be significant in the long run. Most importantly, German policy makers realized that". . . the state could - with adequate coordination - exert considerable

⁷⁶ As a result, the program was renamed to 'Program to Support Data Processing for Government Tasks'.

⁷⁷ B138/1702. "Auszug aus den Studien der JOHN-DIEBOLD-Gruppe "Der Westeuropäische Markt für DV Anlagen" (Bundesrepublik Deutschland, Grossbritannien und Frankreich) sowie erste Schlussfolgerungen, (Bad Godesberg, 1 December 1965), p. 1. The information contained in this paragraph is based on this document.

⁷⁸ "Programm für die Förderung der Forschung und Entwicklung", (Stand: April 1967), p. 3.

influence over data processing in Germany."⁷⁹

German bureaucrats argued that the use of data processing systems in some areas of the public sector differed greatly from that in the private sector. As outlined in the minutes of an interdepartmental meeting that took place on 9 February 1966,

in some cases authorities would apply data processing systems similar to those in commercial areas. For such applications the systems developed for commercial use are sufficient. However, large areas of future application of data processing systems for government tasks were fundamentally different from commercial applications. This was the case, for example, in nuclear research and space research, for programmed teaching (*programmierten Unterricht*), in a command and control system for the *Bundeswehr* or in a comprehensive flight safety system.⁸⁰

In addition, German policy makers strongly believed that funding R and D in the domain of data processing for the purpose of government R and D and educational needs would result in a spin-off for private industry. In fact, one bureaucrat stated that "the experience in the US has shown that such support measures benefit industry."⁸¹

The Importance of R and D as a Basis for Economic Growth:

The Ministry of Economics was not involved in the planning stages of the program, but after the election in December 1966, it showed increased interest in the development of the Federal Support Program for Data Processing. An economic

⁷⁹ "Auszug aus den Studien der JOHN-DIEBOLD-Gruppe", p. 4

⁸⁰ B138/1702, Ergebnisniederschrift, "Ressortbesprechung über Forschung und Entwicklung auf dem Gebiet der Datenverarbeitung," (Bad Godesberg: 9 Februar 1966), p. 3.

⁸¹ "Ergebnisniederschrift", (23 Januar 1968), p. 10.

downturn and disagreement among the coalition partners resulted in the breakup of Erhard's coalition government. In December 1966 the 'Grand Coalition', between members of the two major parties, the Social Democrats and the Christian Democrats, came to power. Ludwig Erhard was replaced as chancellor by Kurt Georg Kiesinger also a Christian Democrat. Karl Schiller, a Social Democrat and the new Minister of Economics, implemented several programs to combat the depression of 1966/67. As he did not believe in the concept of 'complete competition', he modified the premises of the Social Market Economy accordingly. Schiller coined the phrase "as much intervention as necessary, as much competition as possible" and he believed that the state should only intervene on a macro-economic level.⁸²

In June 1967, the government passed the "Act to promote economic stability and growth" (*Gesetz zur Förderung der Stabilität des Wachstums der Wirtschaft, Stabilitätsgesetz*), to allow for government intervention on a macro-economic level. In contradiction to Erhard's aversion to economic planning, the new government passed an act in December 1967 that engaged it in five-year terms of fiscal planning. One of the measures that Schiller implemented in order to combat the recession of 1966/67 was an economic program that injected government funds into the economy (*Konjunkturpolitik*). Although discussions for a federal support program were already underway when the Grand Coalition came to power, Schiller's new economic policy helped the data processing industry in that it added a financial component in the form of low interest loans.

⁸² Joachim Braun, The German Economy, p. 184.

Government officials were convinced that public support over a specified period of time would assist the German data processing industry in becoming more competitive in the domestic and international markets. The program consisted of three components, each of which addressed a major aspect identified in the technology gap: future oriented industrial R and D in the domain of data processing, the development of new data processing applications via demonstration projects, and the support of firms through low interest loans.

The first and largest component of the federal support program was future-oriented industrial R and D, modeled after the recommendations made by Siemens and Halske in the 'Study of the necessary Research and Development for a data processing system for government purposes'.⁸³ Due to the cyclical nature of computer development, i.e. the fact that approximately every five years a new generation of computers would emerge, government officials thought it most appropriate to plan the program for approximately five to six years with the option for renewal, should it become necessary.⁸⁴ Initially, the two departments allocated DM 230 million for this aspect of the program while the firms were expected to provide an additional 50 percent, bringing total funding

⁸³ Arbeitsgemeinschaft Siemens-Telefunken, "Studie über die erforderlichen Forschungs- und Entwicklungsarbeiten" (München, Ulm, 1966). The eight fields included theoretic foundations of data processing systems, integrated circuits, digital scratchpad memory or mass storage device, large capacity memory, in/output devices, packaging technology, automation of development, design and further development of concrete data processing systems.

⁸⁴ B138/1702. "Ergebnisniederschrift: Besprechung über Grundsatzfragen der Förderung und Entwicklung auf dem Gebiet der Datenverarbeitung für öffentliche Aufgaben" (Bad Godesberg: BmwF, 14 September 1966).

available to DM 460 million.⁸⁵

The second aspect of the program consisted of the development of new applications via data processing demonstration projects⁸⁶ with the goal of creating a market for German-produced data processing systems. As stated in the Programm, "[d]emonstration data processing projects should be chosen with the intention to install either a data processing system or a data processing network for government tasks or research".⁸⁷ Initially, the two departments allocated DM 50 million for this aspect of the program, while industry was to contribute DM 20 million. Closely linked to this aspect of the program was a procurement policy that required government departments to give preference to German systems when purchasing new data processing systems. The 'Brain Drain' was addressed with DM 30 million for a central research organization, the "Society for Mathematics and Data Processing (*Gesellschaft für Mathematik und Datenverarbeitung*, (GMD))".⁸⁸ Established in 1968, the GMD incorporated the Institute for Instrumental Mathematics of the University of Bonn and served as a research institute

⁸⁵ "Programm für die Förderung der Forschung und Entwicklung", (Stand: 17 April 1967), p. 33.

⁸⁶ The eight areas were comprised of storage and retrieval of information, an integrated data processing system, Cooperation between several databases (subsystems), Automated documentation of Literature, Linguistic database, Data processing network for Research purposes, multiple access system for research purposes.

⁸⁷ "Programm für die Förderung der Forschung und Entwicklung", (Stand: 17 April 1967), p. 19.

⁸⁸ B138/3507. Ergebnisniederschrift 4. Sitzung, p. 8 und 'Anlage IV zur Ergebnisniederschrift: 5. Sitzung, Fachbeirat für Datenverarbeitung (11 Juli 1967).

as well as a training institute for public servants and researchers.⁸⁹ In addition, DM 2.4 million was spent for the German Computing Centre (*Deutsches Rechenzentrum*) and DM 4.5 million on Nuclear data processing.⁹⁰

A fourth component of the federal support program consisted of credits for production- related and market-oriented support. This aspect of the program was developed within the context of Schiller's economic program. Initially, some tension between the Minister of Scientific Research, Gerhard Stoltenberg, who was a member of the Christian Democrat Party and Social Democrat Karl Schiller, existed over the administration of the funds. Minister Stoltenberg was of the opinion that ". . . the responsibility for all research activities in the domain of data processing should be with the Ministry of Scientific Research." Stoltenberg viewed the intent to provide long-term low interest loans to industry as superfluous, but noted that " if the money is made available, it should be administered by the Ministry of Scientific Research in order to avoid dispersing the funds"⁹¹ Eventually the two ministries came to the agreement that the Ministry of Economics would administer its part of the program. The funding made available by the Ministry of Economics was intended for "support of the development and production of market oriented data processing systems for general commercial

⁸⁹ For a detailed history of the GMD see Josef Wiegand, Informatik und Grossforschung. Geschichte der Gesellschaft für Mathematik und Datenverarbeitung, (Frankfurt, New York, 1994).

⁹⁰ Sommerlatte und Walsh, Die Entwicklung der Datenverarbeitung, p. 80.

⁹¹ B102/157043. Vermerk: 'Betr.: Electronische Datenverarbeitung; hier: Klärung der Zuständigkeitsfrage zwischen dem BMwF und BMWi', (Bonn: 1 März 1967), p. 1.

requirements."⁹² Support was to be given in the form of long-term, low interest loans consisting of up to fifty percent of the total anticipated costs of an undertaking. A minimum of fifty percent of the cost would have to be carried by a firm itself. According to Tom Sommerlatte's report, Die Entwicklung der Datenverarbeitung, the Ministry of Economics made available DM 115 million for the duration of the first Federal Support Program for Data Processing.⁹³

Not part of the Federal Support Program, but coordinated with it was the DFG program "Information Processing and data transmission" (*Nachrichtenübertragung*), administered by the Ministry of Scientific Research.⁹⁴ The purpose of this particular DFG program was limited to the support of data processing in colleges and scientific institutes and was intended to provide funding for research in various areas of information processing as well as to ensure an ample supply of new recruits in this burgeoning technological field. The program allowed for the support of individual research projects at colleges and scientific institutions conducted by individual researchers.⁹⁵

In the early stages of the Federal Support Program, the focus was on financing

⁹² "Entwurf: Brief von dem Bundesminister für Wirtschaft an den Chef vom Büro des Bundeskanzlers." Betr.: Investitionshaushalt; hier: Förderung der elektronischen Datenverarbeitung (EVD), (Bonn: März 1967), p. 2.

⁹³ Tom Sommerlatte und Walsh, Die Entwicklung der Datenverarbeitung, p. 84. A breakdown for the funding per year could not be located.

⁹⁴ B138/1702. Brief "An den Herrn Bundesminister für wissenschaftliche Forschung" (24 February 1966).

⁹⁵ For a list of individual projects see B138/1703. "Übersicht über die Ressortforschung auf dem Gebiet der Datenverarbeitung sowie Schwerpunktprogramme "Informationsverarbeitung und Nachrichtenübertragung" der DFG, Anlage A" (Bad

medium to large size data processing systems, while process computers and small systems were to be financed by the firms themselves.⁹⁶ It was noted in the blueprint for the Federal Support Program, the "*Programm für die Förderung der Forschung und Entwicklung auf dem Gebiet der Datenverarbeitung für öffentliche Aufgaben,*" that on 1 July 1966, approximately 90 percent of all data processing systems on order in Germany were for small computers intended for commercial use. As a result, German policy makers felt that this section of the market did not require support. They argued that the spin-off from developing medium and large sized systems would be sufficient for firms to enable them to finance the development of small systems on their own.⁹⁷

Administration of the Program:

A very interesting aspect of the program is that there was no plan to develop a specific data processing system. Instead, the stated aim was to increase the efficiency of the German data processing industry in eight specific fields.⁹⁸ In order to qualify for funding, interested firms were asked to submit a detailed proposal related to an applicable field.

Godesberg: BmWF, 26 Juni 1967), pp. 5 - 9.

⁹⁶ "Richtlinien und Programm für die Förderung der Forschung und Entwicklung," (Stand: 10 Januar 1967), p. 24.

⁹⁷ "Richtlinien und Programm für die Förderung der Forschung und Entwicklung," (Stand: 10 Januar 1967), p. 25.

⁹⁸ The eight fields included theoretic foundations of data processing systems, integrated circuits, digital scratchpad memory or mass storage device, large capacity memory, in/output devices, packaging technology, automation of development, design and further development of concrete data processing systems. "Programm für die Förderung der Forschung und Entwicklung, (Stand: April 1967), p. 33.

The greatest challenge facing German government officials was the administration of the program. For this purpose the Minister of Scientific Research created a committee that initially comprised twelve members from the scientific community, two representatives from the DFG and a chair from the ministry.⁹⁹ At a later stage, a representative from the Ministry of Economics, and two representatives of users of data processing systems were added to the committee. A proposal to include a representative from industry was denied on the basis that it would compromise the impartiality of the committee.¹⁰⁰ Members were appointed for a two year term by the Minister of Scientific Research based on their expertise rather than their affiliation with a particular institution. Named the *Fachbeirat für Datenverarbeitung*¹⁰¹ the committee included experts in computer design, hardware, and applications.

The committee represented the interests of industry, government and the scientific community and was responsible for all components of the program.¹⁰² Its task was to evaluate and examine the proposals for R and D projects submitted by data processing firms after a first screening by the Ministry of Scientific Research; to evaluate the

⁹⁹B138/3502. "Verfügung über die Bildung eines Fachbeirats für Datenverarbeitung", (Der Bundesminister für wissenschaftliche Forschung, (17 December 1966), p. 2. The chair was appointed for one year, while the members were appointed for two years.

¹⁰⁰B102/157040. "Ergebnisniederschrift 9. Sitzung, Fachbeirat für Datenverarbeitung", (9 April 1968), p. 9.

¹⁰¹ Expert Committee for Data Processing.

¹⁰²B138/1703. "Vorschläge für die fachliche Beratung des BMwF auf dem Gebiet der Datenverarbeitung", (14 November 1966), p. 1.

progress and/or completion of projects in progress as directed by the Minister of Ministry of Scientific Research; and to recommend R and D projects and other measures that would benefit the German data processing industry (DFG support programs were not affected).¹⁰³ In short, members of the committee were to provide expert advice on specific R and D projects to German bureaucrats as well as to monitor the progress on individual projects.

The expert committee met regularly in Bad Godesberg (near Bonn) and often included guests from the scientific community, federal government and industry. Industrial representatives were asked to leave during the discussion of proposals. The first three committee meetings focused on finalizing the document that formed the basis for the federal support program for submission to Parliament.¹⁰⁴ During subsequent meetings, committee members consulted on the proposals from individual firms in order to determine whether or not these qualified for financial support for the proposed R and D projects and they dealt with other issues related to the federal support program. The expert committee also formed numerous ad-hoc committees in order to provide technical advice (consultations) and to coordinate individual data processing demonstration projects.

¹⁰³ B138/3502. "Verfügung über die Bildung eines Fachbeirats für Datenverarbeitung", p. 1.

¹⁰⁴ The document that formed the basis for the Federal Support Program was "Programm für die Förderung der Forschung und Entwicklung auf dem Gebiet der Datenverarbeitung für öffentliche Aufgaben." (Stand: 17 April 1967). Meetings in January, February and March consisted of consultation regarding the content of this document. In April 1967, a revised version was made available.

Members of the committee were assigned to specific R and D subject areas based on their expertise and they reviewed proposals related to these specific subject areas. Members of the committee assessed the proposals based on how important/valid the proposed project was in relation to future oriented R and D in the domain of data processing. The committee's formal recommendations to the Minister of Scientific Research were coded as follows:

- 1: Urgent, highest priority for support;
- 2: Important for data processing, qualifies for support;
- 3: Interesting for data processing, but the proposed project does not necessarily belong to the program of the Ministry of Technology;
- 4: The project does not belong (qualify) for the federal support program of the Ministry of Technology.¹⁰⁵

Proposals evaluated as category 3 or 4 were not necessarily eliminated from the program.

A coding of 3 or 4 was given if the proposed project fell under the jurisdiction of the Ministry of Defence, the DFG or the Ministry of Economics. A coding of 4 was also assigned to projects that did not qualify for any of the funding.

To qualify for federal support, firms had to prove that they would be able to contribute fifty percent of the total cost proposed for the project. The purpose, as stated in the federal program description, was to ensure that individual firms would have a vested interest in the research project and that they undertook only projects that could realistically be completed. This also ensured that firms had an interest in moving the project into the production phase to ensure recovery of the R and D investment.

¹⁰⁵ B138/3508. "Ergebnisniederschrift, 6. Sitzung, Fachbeirat für Datenverarbeitung," (13 September 1967), p. 1. These were listed on the tables outlining the recommendations to the BMWF for each Expert Committee Meeting.

While this method of granting federal support money based on proposals allowed smaller firms to compete; the fact that they needed fifty percent of the capital to qualify posed a great disadvantage to them. As a result, smaller firms competed for a limited number of smaller projects leaving the bulk of the available federal money to the two largest firms, Siemens & Halske and AEG-Telefunken, which had set the direction of the Federal Support Program with their study *'Die erforderlichen Forschungs und Entwicklungsarbeiten für ein Datenverarbeitungssystem für öffentliche Aufgaben'*.

The Federal Support Program allowed policy makers to make adjustments as deemed necessary in order to consider and incorporate new breakthroughs and developments in the domain of data processing. For example, the focus of the program was reconsidered after Minister Dr. Stoltenberg visited MIT on 21 and 22 September 1967. During this visit, members of his entourage became aware that in the U.S. the focus of data processing systems had shifted from the arithmetic unit of the computer to faster large storage systems. Upon the group's return to Germany, a member of the delegation recommended that the "committee take a more active role in supporting data processing. . . . [and] with participation of German industry develop a detailed plan for futuristic lines of development."¹⁰⁶

In developing the Federal Support Program, German policy makers, like their colleagues in other OECD countries, were guided by the understanding that large firms fared much better in research intensive industries because they had greater resources at

¹⁰⁶ B138/3508. "Ergebnisniederschrift 7. Sitzung Fachbeirat für Datenverarbeitung", (15 November 1967) p. 8.

their disposal than smaller firms. The general understanding was that large firms were in a much better position to contend with the financial risks associated with the development of data processing technology. As a result, Siemens & Halske and AEG-Telefunken, the two largest electronics firms in Germany received the bulk of support from the federal support program. Almost half of the funding, 49.5 percent, went to Siemens, while AEG-Telefunken received 36.7 percent.¹⁰⁷ The remainder of the funding was shared among a number of the smaller firms. The German success story, *Nixdorf*, which specialized in small computers and had also gained inroads into the American market received just 1.4 percent of the funding.

To avoid giving undue advantage to one versus the other of the two large firms, the Expert Committee had to ensure a balance in awarding contracts. In several instances the committee intentionally approved projects for one of the two large firms even though the other firm was already involved in a similar project. A specific example is R and D in relation to integrated circuits. At the committee meeting in May 1967, several members noted that "financing of duplicate work in the area of integrated circuits was justifiable, since neither of the two firms [Siemens & Halske and AEG-Telefunken] could forego development in this area because of the fundamental importance of such research"¹⁰⁸. In other cases such as R and D related to large storage systems (LCMs), the committee recommended that the two firms consult with one another, since duplication could not be

¹⁰⁷ Tom Sommerlatte und Walsh, Die Entwicklung der Datenverarbeitung, p. 98.

¹⁰⁸ B138/3507. "Ergebnisniederschrift, 4. Sitzung Fachbeirat für Datenverarbeitung," (22 Mai 1967), p. 5.

warranted for financial reasons.¹⁰⁹ Committee members carefully weighed the options to ensure that neither one of the two large firms was put at disadvantage.

The German Program within the Context of International Development:

The German Federal Support Program was not developed in isolation from international developments. Firms that qualified for federal funding had to consider developments made by foreign firms and especially American firms. For example, if members of the Expert Committee were aware of a development or breakthrough in relation to a proposal under evaluation, they requested that the firm take those developments into consideration in the context of their own work.¹¹⁰

Foreign firms were not systematically excluded from government funding. For example, a German subsidiary of the Dutch firm Phillips, as well as the Swiss firm Brown & Boveri, the British firm, Standard Electric Lorenz and Agfa Geveart¹¹¹ qualified for funding and were awarded several small contracts. The German data processing program included the specification that in order to be considered for funding, firms had to operate within the jurisdiction of the Federal Republic and not receive support from a foreign government. This stipulation effectively excluded firms such as IBM, as well as French and British firms that received government funding.

The contribution of foreign firms to the German data processing industry was also

¹⁰⁹ "Ergebnisniederschrift, 4. Sitzung Fachbeirat für Datenverarbeitung," (22 Mai 1967), p. 5.

¹¹⁰ B102/157040. Ergebnisniederschrift, 10. Sitzung Fachbeirat für Datenverarbeitung, (22 Mai 1968).

¹¹¹ B102/157040. "Ergebnisniederschrift, 9. Sitzung. Fachbeirat für

acknowledged in the context of partnerships between foreign and German firms. For example, the German firm Siemens & Halske, which had entered into a partnership with the American firm RCA, was one of two German firms receiving the largest share of federal funding during the first Federal Support Program. This may be due to the fact that representatives from Siemens & Halske were ultimately responsible for soliciting government support and had a close relationship with German government officials. On the other hand, together with the fact that non-German firms received funding for select projects, it shows an effort to judge projects on value of contribution despite the nationality of the firm. That is not to say that German firms were not preferred, but if the committee saw value in a unique project they would recommend it for funding.

Conclusion:

This chapter has analyzed the development and implementation of the German Federal Support Program for Data Processing that was developed in close consultation with industry. Representatives from the two largest German data processing firms, Siemens & Halske and AEG-Telefunken, were directly involved in the program from beginning to end. The program was developed from the bottom up with the cooperation of industry, government and the scientific community, and was greatly influenced by the political philosophy of the Social Market Economy. The Federal Support Program was developed with the purpose of improving the economic standing of the German data processing industry in the domestic as well as in the international market and was driven by the conviction that industrial R and D was the key to economic prosperity. The belief

that large firms were in a better position to complete large, expensive R and D projects resulted in the two largest data processing firms receiving over 86 percent of the available funding, leaving several smaller firms to compete for the smaller projects.

CHAPTER 4:

The French Response

Introduction:

French government officials perceived the issues related to the technology gap as a direct threat to French national sovereignty. They feared that if France were unable to maintain a national computer industry, it would become entirely dependent on American technology. At the time, the French military and nuclear capability were important symbols of national pride and independence. By the mid-1960s, French policy makers realized the importance of computer technology in relation to defence activities as well as to the development of nuclear power. As a result, they came to view an independent national computer industry as essential to their nuclear and military independence from the United States. Like their German counterparts, French policy makers responded to the issues related to the technology gap with a national program to rescue the indigenous computer industry from its decline.

Unlike Germany, France was and still is a centralized state. In 1958 when Charles de Gaulle, established the fifth Republic, he centralized power in the office of the President. De Gaulle's ardent nationalism and anti-American sentiment ensured that he had a special interest in the establishment of a French computer industry and he kept a close eye on the development of the program. In contrast to the decentralized, jointly administered Federal Support Program in Germany, the French *Plan Calcul* was developed and directed top-down by the French government under the close supervision

of Charles de Gaulle.

The *Plan Calcul*, which came into effect in April 1967, was the first of several plans designed to ensure that the French retained a viable computer industry that could compete against American computer firms and in particular against IBM in domestic as well as in international markets. Government support for the French computer industry focused on R and D related to the development of a range of compatible systems similar to IBM's System/360 and, to a lesser degree, on the education of personnel required for a viable computer industry.

The structure of the French program was defined by French nationalistic ambitions and the desire for technological independence. The Plan was implemented top down, and the sole beneficiaries of the funding were three firms created by the French government.

The French Computer Industry:

As early as 1963, French policy makers were concerned about the situation in the French computer industry. A confidential report by *the Commissariat général du Plan, Commission Permanente de l'électronique*, evaluated this situation.¹ According to this report, IBM was already very strongly entrenched in the French computer market. The French firm *les Machines Bull* was the largest and most successful of several French firms. In the early 1960s, the firm was dominant in the French computer market and was

¹ Commissariat Général du Plan, Commission Permanente de l'électronique, "Note confidentiel sur les calculatrices électronique," N° 63.107/COPEP, Septembre 1963.

the second largest manufacturer of electronic business machines in the world.² As such, the firm was the flagship of French economic success and national pride.

The firm was founded in 1931/32 and became an international company with subsidiaries in several European countries. Bull experienced tremendous growth as the punched card business peaked in the 1960s. To sustain this growth, Bull invested heavily in personnel and infrastructure. In 1962, the bubble burst, and as the market for punched cards became saturated, the profits of Bull diminished. One of the reasons was that Bull had overextended itself; another was that the firm could not make the technological adaptations necessary to compete in an international market that was increasingly moving towards electronic computers. In addition to the technological adjustments, Bull, like other Western European computer firms, was dealing with the costly restraints associated with training personnel in utilizing and servicing electronic computers as well as with the practice of leasing.³

Leasing was a longstanding practice in the business equipment industry. It is important to remember that the computers of the 1960s are in no way comparable to the computers of today. They were colossal machines that took up entire rooms and the purchase price for these machines ranged up to several million dollars. By leasing, the customer had the use of the computer, without the enormous costs associated with

²Pierre Monier-Kuhn, "Bull: A World-Wide Company born in Europe," Annals of the History of Computing. Vol. 11. No. 4 (1989): p. 290.

³This paragraph is based on information from "Bull: A World-Wide Company born in Europe," Annals of the History of Computing. Vol. 11. No. 4 (1989): pp. 283-293.

purchasing. Because of leasing, computer firms needed a large operating capital to cover the initial costs, since full recovery of production costs took 3 to 4 years.⁴ The practice of leasing made it difficult for firms to enter the computer industry, and in most cases the smaller European firms did not have the capital resources to cope with the costs.

The 1963 report by the *Commissariat général du Plan, Commission Permanente de l'électronique* noted that IBM was growing at a much faster rate (refer to Table 2) than the national firm *les Machines Bull*. As electronic computers displaced the widely used punched card machines, Bull was unable to keep pace and by 1963, just before IBM introduced its System/360, Bull was in serious financial trouble. According to the 1963 report, the introduction of the second generation computer IBM 1401, in 1960 posed a major challenge, and Bull continued to lose sizeable shares of the French market. For first generation computers *Bull* was in control of 70 per cent of the French computer market compared to 30 per cent for IBM. With the introduction of the IBM 1401, IBM seized 64 percent of the French market, while Bull's share declined to 22 percent. The report noted that French policy makers were aware of the situation, but hoped that Bull would recover from its financial difficulties and compete with IBM in the domestic as well as the international markets.⁵

⁴ OECD, *Gaps in Technology; Electronic Computers*, p. 120.

⁵COPEP, "Note confidentiel sur les calculatrices électronique," p. 14.

Table 6: Turnover in Million FF⁶

	1961	1962	%
Bull	287	345	+20
IBM	611	863	+41

In December 1963, the American computer firm General Electric (G.E.) offered a capital infusion in exchange for twenty per cent of Bull's shares.⁷ G.E. was searching in this way to make inroads into the growing European computer market. Since Bull needed the French government's approval to sell shares to a foreign company, Joseph Callies, its President, informed the Prime Minister of G.E.'s offer and asked for the appropriate approval. Callies emphasized the urgency of his request due to the fact that *Bull* was facing a financial crisis. Despite this urgency, the government's response was delayed, partly due to the fact that the Minister of Finance, Giscard d'Estaing, was out of the country. It was not until February 4, 1964, that Giscard D'Estaing notified Callies, that, after looking into the matter, it was not possible to grant approval.⁸ As a result, the managers of the firm were forced to search for other solutions.

Negotiations with other firms, as well as with the French government, for financial aid ended in failure, and in 1964 General Electric acquired fifty-one percent of

⁶ COPEP, "Note Confidentiel sur les calculatrices électronique,"p. 15.

⁷ Letter from J.B. Lockton, General Electric, in Georges Vieillard, L'Affaire Bull (France, 1968), p. 35 - 38.

⁸ Letter from Giscard d'Estaing, Minister of Finance (Paris, February 4, 1964), in Georges Vieillard, l'affaire Bull, p. 62.

Machines Bull, instead of the twenty percent as initially proposed.⁹ Not only that, but the financial crisis in Bull that had developed as a result of the government's lack of support, resulted in a much lower purchase price for the shares which G.E. finally acquired. Ninety-one percent of the French computer market was now under the control of American firms, with IBM alone in control of sixty-three percent.¹⁰ The result was not beneficial for French national pride.

It is difficult to determine if *Bull* would have been better off had the government given its approval when G.E. was ready to buy twenty percent of Bull's shares. One of the major problems in the relationship between the French government and industry appeared to be that the bureaucracy was unable to keep pace with the needs of industry. Bull's management had to contend with a slow bureaucracy in order to obtain approval to sell its shares to G.E. The government's delay in rendering a decision cost the company valuable time in which it could have sought other solutions.

French Economic Planning:

Jean Monnet, a French businessman and later a leader in the drive toward European integration, devised and implemented the first French economic plan. During World War II, Monnet spent two years in exile in the United States. Upon his return to France after the war, Monnet perceived France to be far behind other Western European countries in economic development. Monnet, who became the first French

⁹This information is based on a chapter in John H. McArthur, and Bruce R. Scott, Industrial Planning in France, pp. 359 - 376.

¹⁰OECD, Electronic Computers, Gaps in Technology (Paris, 1969), p. 19.

Commissioner for Planning in 1946, was of the opinion that if France were to become competitive within an international environment, “modernization and reconstruction must go hand in hand.”¹¹ The goal of the first French plan (1946-1953) was to facilitate economic reconstruction and modernization as well as to administer and direct American Marshall Aid funds.¹² To administer the plan, a Planning Commission (*Commissariat au Plan*) was created in 1946. The Commission was rather small with only about 140 white collar staff. The planners themselves had very little power as they had no budget of their own. Financial authority rested with the Ministry of Finance,¹³ which controlled public investments and provided economic advice to the private sector.¹⁴

Although economic planning implies government intervention, the goal of French planning was not to direct the economy by coercive means, but to coordinate and distribute economic information.¹⁵ French economic planning was facilitated by an indicative approach, or market research approach, to planning. Information collected by planners was made available to industry so it could make its economic forecasts based on the data provided.¹⁶ The first plan comprised a series of detailed investment strategies,

¹¹Jean Monnet, Memoirs, George W. Ball, transl. (Garden City, New York: Doubleday & Company Inc., 1978), p. 237.

¹²Saul Estrin and Peter Holmes, French Planning in Theory and Practice, p. 62.

¹³Yves Ullmo, “France,” Planning, Politics and Public Policy, p. 23.

¹⁴Stephen Cohen, Modern Capitalist Planning: The French Model, p. 27.

¹⁵Saul Estrin and Peter Holmes, French Planning in Theory and Practice, p. 1.

¹⁶Jean-Jacques Bonnaud, “Planning and Industry,” in Planning, Policy, and Politics, eds. Jack Hayward and Michael Watson, (London: Cambridge University Press,

which focused on six basic sectors of the economy, namely coal, steel, electricity, cement, agricultural machinery and transport that were vital to rebuilding the French economy after World War II. While it is beyond the scope of this paper to discuss each plan in great detail, it should be noted that each was formulated in response to a particular economic problem, and had its own 'theme'.¹⁷ The first three plans (1946 - 1961) focussed on economic reconstruction, while the fourth and fifth plans (1961 - 1970) were oriented toward strengthening the national capacity in an economic environment that was increasingly subject to international competition.

It is within the context of the fifth plan, aimed at strengthening the competitive capacity of the economy, that French industrial policy of the 1960s must be evaluated.¹⁸ The fifth Plan (1965-1970) was a direct response to European integration and to the 'American Challenge.' French industry, like that of most other Western European countries was, until World War II, sheltered by high tariff barriers. With French entry into the Common Market in 1958, these barriers were progressively eliminated, and French industry was forced to compete in an open market. The Common Market opened the doors to an increase in American direct investment. However, in the context of the emerging French computer industry, the major concern for French policy makers and

1975.), p. 95. Although a little dated, Stephen S. Cohen Modern Capitalist Planning the French Model, is a good study on the administrative structure of the plan as well as the planning process.

¹⁷For more detail on plans one to five, see John H. McArthur and Bruce R. Scott, Industrial Planning in France.

¹⁸McArthur and Scott, Industrial Planning in France, p. 50-52.

industrialists was the establishment of American subsidiaries.

Centralism:

The roots of French interventionism do not lie in economic planning, but rather in a centralized State dominated by President General Charles de Gaulle. The French computer support program, the *Plan Calcul*, was developed within the context of the centralized state structure of the fifth Republic. While the West German Federal State was built on negotiation and compromise, the fifth Republic, rested on the authority of its President. De Gaulle was determined to ensure French national independence and was adamantly opposed to American hegemony. Essentially, his desire was to ensure that France remained politically and economically independent as the two superpowers, the United States and the Soviet Union, struggled for dominance on the world stage. In his pursuit of technological independence, Charles De Gaulle took a personal interest in the success of the French computer industry and, as a result, the development of industrial policy in this sector became directly linked to his quest for national independence and his anti-American sentiment. As such, De Gaulle's political goals became closely intertwined with the economic policy of the computer industry. The *Plan Calcul* reflected these goals.

Soliciting Government Support:

What further complicated matters for de Gaulle was that between 1963 and 1966, the American government put an embargo on the export of large computers to France. Since the French computer industry was virtually wiped out after the take-over of *Machines Bull* by G.E., the French government feared for its economic and political

independence. As pointed out by John Walsh, “[g]rounds for the embargo were such that computers could abet French nuclear weapons development, and that delivery should be forbidden under the nondissemination provisions of the Moscow Test Ban Treaty.”¹⁹ It was at this point that the French government came to the painful realization of its dependence on American computer technology. It was also at this time that the idea of a technology gap between the United States and Europe was recognized as a serious threat of national proportions.

The technology gap received much publicity during a legislative election campaign in 1967. The Minister of Science, Alain Peyrefitte, used it as a means to lobby the government for an increase in funds for research in science and technology. As pointed out by John Walsh,

in the argument developed during the campaign, principally by Peyrefitte, the United States was used as both an example and a threat. American industry has devoted much more effort and money to research than French industry has, Peyrefitte noted, and heavy expenditures by the U.S. government on defense and space research, particularly in the private sector, have given the United States a long lead in vital high-technology industry. If France is to maintain independence of action in the economic as well as the military sphere, it is necessary for the French government to take action against what the French call, for short, “*le gap*”.²⁰

Even before Peyrefitte's campaign, however, the French government, the *Conseil Economique et Sociale*, had initiated a study of the electronics sectors of Great Britain, Japan, United States, and Germany, in order to better direct policy for the French

¹⁹John Walsh, “France: First the Bomb, Then the Plan Calcul,” *Science*, vol. 156 (12 May 1967): 767.

²⁰John Walsh, “Some New Targets Defined for French Science Policy,” *Science*

computer industry. Commenced in 1965, it evaluated the entire electronics sectors of the five countries. A first report issued on 14 March, 1966, analyzed the general character of the French electronics industry and compared it with the industries of the four other countries. As pointed out in the report, the objective was “. . . to better understand the situation of our French electronics industry and to define appropriate measures for development in the future.”²¹ The report related to the electronics industry as a whole, but it also reflected the problems faced by the computer industry. Furthermore, French policy makers recognized that the budding computer industry "appeared to be the motor of the electronics industry and will become preponderant in coming years." ²²

One aspect that must be considered when evaluating French government intervention in the computer industry is that with the completion of the study and all the publicity surrounding the 'technology gap', French policy makers realized the importance as well as the potential of the computer industry within the context of the national economy as a whole. The total estimated value of the French computer industry was approximately 2.2 billion FF in 1964 and it was expected to grow by 22 percent a year to 6.5 billion FF by the end of 1970.²³ French industrialists and politicians were very well aware that, unless the French effectively competed in the domestic as well as in the

vol. 155 (5 May 1967): 629.

²¹Bernard Kuhn de Chizelle, Situation de L'Industrie Electronique Francaise, Projet de Rapport, Conseil Economique et Sociale, Section de la Production Industrielle et de l'Energie, AK/RD, 278/Sec/9/26, (Paris: 14 March 1966), p. 4.

²² Bernard Kuhn de Chizelle, "Situation de l'industrie électronique", p. 4.

²³ Bernard Kuhn de Chizelle, "Situation de l'industrie électronique", p. 4.

international market, American firms in general and IBM in particular would reap the benefits of this tremendous economic growth. Computer professionals wanted the French government to 'rescue' the troubled computer industry from American domination. They therefore lobbied the DGRST (*Délégation Générale à la Recherche Scientifique et Technique*) and the *Commissariat général au Plan* for large scale government involvement to stimulate development in the computer sector.²⁴ The DGRST was created in 1961 and along with the CCRST (*Comité consultatif de la recherche scientifique et technique*) it cooperated closely with the *Commissariat général au Plan*.²⁵ The DRST and the CCRST were put into place by General de Gaulle himself with the intent to focus on national science policy within the context of the fifth national plan.²⁶ Amid all these considerations, the French government chose to provide financial support to its national computer industry. These arguments also provided the backdrop for the French *Plan Calcul*.

French Government Support as the Foundation for the Plan Calcul:

French policy makers acknowledged that the dynamics and quality of

²⁴Pierre E. Monier-Kuhn, "Prologue: History of Computing in France," Annals of the History of Computing, vol 11, No. 4 (1989): p. 237.

²⁵ G. Ramunni, 'Entre recherche fondamentale et développement industriel: L' action de la DGRST en faveur du développement des calculateurs électroniques (1959-1966), in Deuxième colloque sur l'histoire de l'informatique en France (Conservatoire National des Arts et Métiers: Paris, 24,-25-26 Avril, 1990), Eds. Philippe Chatelin et Pierre-E. Mounier-Kuhn. p. 338.

²⁶ G. Ramunni, 'Entre recherche fondamentale et développement industriel', p. 337.

management, the technology gap and the dimension of the American internal market were important factors in the dominance of American computer firms; however, like their German counterparts, they viewed American government support for the computer industry as the single most important factor in the success of American firms.²⁷

Industrialists and French government officials were therefore of the opinion that within the international environment, French firms were operating with a definite disadvantage in comparison to American computer firms. French policy makers held that only with comparable government support could the French computer industry achieve success.

In the mid-1960s French economic policy changed in response to the Bull Affair and the embargo on computers. Prior to 1965, the French government under Charles de Gaulle had focussed on research and development for military and nuclear objectives. The issues related to the 'technology gap' made French policy makers aware that military prowess alone was no longer enough to ensure a nation's independence. As military technology became increasingly sophisticated, military power came to depend increasingly on technological innovation, which in turn was highly dependent on government support for R and D. The French government stated that if it failed to develop its own computer technology, it would become utterly dependent on the United States for civilian as well as for military computer technology. John Zysman points out, that as a result, the, "French government pursued a political goal of technological

²⁷ "Bilan du PLAN CALCUL, 1966 - 1973," p. 74 - 78.

independence by directly supporting and protecting certain electronics firms.”²⁸

The French Plan Calcul:

French policy makers focused on two key aspects of industrial policy. The first objective was to create scientific and political institutions to direct and control R and D in the domain of electronic computers. In contrast to the German Federal Support Program, the development and administration of the French Plan Calcul was centralized in the hands of the top echelons of the government. In 1966 the government created the *Délégation à l’informatique*, which was responsible directly to the Prime Minister. Robert Galley, an engineer and businessman as well as a devoted Gaullist, was appointed to head this group and was responsible directly to the Prime Minister.²⁹ R.A. Lefebvre, Attaché for Scientific Affairs at the Canadian Embassy, reported that, “[i]t was decided that, as far as relations between the government and industry were concerned, the Commissioner would be the only government representative dealing with industry and that he would coordinate the activities of the various departments and governmental agencies involved in information science.”³⁰ The new organization was mandated to oversee the restructuring of the computer industry. It controlled funding for this objective, it was responsible for defining strategy and for developing a research and

²⁸John Zysman, “French Electronics Policy: The Costs of Technological Independence,” p. 227.

²⁹Jean-Michel Quatrepoint et Jacques Jublin, avec la collaboration de Danielle Arnaud, French Ordinateurs; de l’affaire Bull a l’assassinat du Plan Calcul (Paris: Alain Moreau, 1976), p. 32.

³⁰R.A. Lefebvre, Attache, Information Science, “THE FRENCH “PLAN CALCUL,” (Paris, France: Canadian Embassy, May 1970), p. 3.

development policy.³¹

At the same time, Galley was also the Chairman of the Standing Committee of the Plan for electronics (COPEP). Lefebvre pointed out that, “this committee acts as a permanent advisory council working for the government and deals with problems concerning French electronic industries; . . . Thus, the Commissioner is in a position to be informed on and influence the overall electronics policy of the country.”³² It appears as if the Commissioner acted as a middle-man, a broker, between the government and private industry during the study phase of the Plan Calcul.

In January 1967, the government set up the IRIA (*Institut de Recherche en Informatique et Automatique*), a Research Institute for Information Processing intended to offset the 'brain drain' by training specialists and professionals to develop, design, sell and maintain computers. In addition, the institute functioned to acquire scientific and technical knowledge for research in the domain of electronic computers.³³ The government covered all expenses of this agency, which controlled R and D and provided the institute with just over 30 million Francs in 1968, 31 million Francs in 1969 and 20 million Francs in 1970. The training of technical and professional personnel was seen as a foundation for future success in the computer industry and addressed the issues related to the brain drain discussed in Chapter 1. Without trained personnel, the French

³¹ "Bilan du PLAN CALCUL, 1966 - 1973," p. 6 - 7.

³²R.A. Lefebvre, (Attache, Scientific Affairs), THE FRENCH "PLAN CALCUL" (a French program for developing a computer-based industry), (Paris, France: Canadian Embassy, May, 1970), p. 4.

³³"Bilan du PLAN CALCUL, 1966 - 1973," p. 54-55.

government could not possibly maintain a viable computer industry.

A second objective of the French government was the creation of a viable computer industry that included the manufacture of hardware, peripherals and components. Like their German counterparts, French policy makers were convinced that only large firms would be able to compete against the American giants. To address the issue of firm size, the French government created a single firm that was intended to take the lead in facilitating the development and manufacture of computers. This computer firm would receive financial support from the government until it could hold its own in the international marketplace.³⁴

To avoid spreading resources, the French government decided to concentrate its aid on a single enterprise. At a meeting on April 13, 1967, the Minister of Economics and Finance and the Minister of Scientific Research and Industry, in cooperation with officials of the companies involved, signed an agreement which merged two of the remaining smaller French electronics firms, SEA (*Societe d'Electronique et d'Automatisme*) and CAE (*Compagnie Europeenne d'Automatisme Electronique*) into CII (*Compagnie internationale pour l'informatique*). The official duration of the contract was five years.

It is unclear from the available documentation what criteria the government used in choosing the two firms for CII. To be sure, the two firms operated under very different strategies prior to the merger, and the difficulty in merging competing firms with

³⁴R.A. Lefebvre, THE FRENCH "PLAN CALCUL", p. 5.

different product lines should not be underestimated. The one incentive that most likely motivated the two firms to cooperate was the substantial subsidies that the newly created firm would receive.

SEA, a subsidiary of the Schneider Group, created in 1948, had developed and manufactured a number of computers. Its first stored-program computer, the CAB 500, came on the market in 1955, followed by the CAB 2024 in 1957, which used magnetic tapes.³⁵ The SEA 3900 was a medium-sized, transistorized business computer that offered an alternative to the IBM 1401. As a small, little known company, SEA was not able to compete against IBM and only approximately 40 units of the SEA 3900 were sold by the time SEA was absorbed in the merger that formed CII. At that time, the firm had 800 employees, a portfolio of 1500 patents and a turnover of 50 million Francs.³⁶

CAE, the second firm, a joint subsidiary of two large electronics firms, CSF Intertechnique and the Compagnie Générale d'Electricité, was created in 1960 with CSF Intertechnique as the principal operating partner. At the time, the firm produced real time computers for military, scientific and industrial applications, most notably the 9.010., 9.040 and 9.080, under the license of Scientific Data Systems (SDS), an American firm.³⁷

³⁵ Pierre Mounier-Kuhn, "Product Policies in two French Computer Firms: SEA and Bull (1948 - 64)" in Information acumen; The understanding and use of knowledge in modern business, ed. Lisa Bud-Frierman, (Routledge: London and New York:, 1994), p. 114-115. Raymond François-Henri, "An Adventure with a Sad Ending: The SEA", in Annals of the History of Computing, Volume 11, (Number 4): 1989, p. 270-275.

³⁶ Pierre Monier-Kuhn, "History of Computing in France", (unpublished manuscript), p. 21.

³⁷ Frédéric Florent, "L'an I du Plan Calcul" in Industrie (20 Mai 1986), p. 9.

When CAE was merged with SEA in 1967 to form the French computer firm CII, this licensing agreement was still in effect.³⁸

The goal of the French government was for CII to assume the position that *Machines Bull* once occupied: to become the second largest computer firm in the world next to IBM.³⁹ To achieve this goal, French government officials and industrialists planned to produce and market a range of medium and large computers by 1969-70. Realizing the success of the IBM System/360, CII was to develop a compatible range of computers, called *Gamme 1* (later renamed IRIS). This range was to consist of two military computers, the P0M and the P2M, as well as the P1 and P3. Taking into consideration the rapid development of computer technology, future oriented research was to culminate in *Gamme 2*, a second range of computers.

Administration of the Program:

Unlike the German Federal Support Program, which was administered by an Expert Committee composed of representatives from government, industry and the scientific community, the French *Plan Calcul* was administered and directly by the French government; CII received approximately 410 million FF in research and development contracts from the French government and 80 million FF in loans over a period of five years.⁴⁰

³⁸ "Bilan du PLAN CALCUL," 1966 - 1973, p. 85.

³⁹ "Bilan du PLAN CALCUL," 1966 - 1973, p. 80.

⁴⁰ "Bilan du PLAN CALCUL," 1966 - 1973, p. 88.

Table 7:

**Government financing for CII:⁴¹ (Financement des marchés d'études de la
C.I.I)**

In million French Francs

	1966/67	1968	1969	1970	Total
<i>Gamme 1</i>	76.6	85.4	73.6	75	310.6
<i>Gamme 2</i>	2.4	10.3	18.5	9.8	41
Total Computers	79	95.7	92.1	84.8	351.6
Components/Peripherals	1	11.7	17.3	31.2	61.2
Total					412.8

Of the total amount, approximately 310 million FF were provided for *Gamme I* compared to only 41 million FF for *Gamme II*, while approximately 60 million FF was reserved for components and peripherals. These funds were intended to provide financial support to CII to conduct R and D in the domain of computers. During the first few years, CII focused on general R and D as well as on the development of the Po and the P2. It should be noted that research pertaining to *Gamme 2*, the future range, was seen as less urgent because *Gamme 1* machines, in particular, Po and the P2, enjoyed success for longer than anticipated.⁴² The state also provided indirect support in the form of 60 million FF in loans, which were repayable in 15 years at an interest rate of 6.5 percent should the firm be successful in developing and manufacturing computers.

Ironically, for the first three years, the Plan Calcul, which was designed to create a

⁴¹ "Bilan du PLAN CALCUL," 1966 - 1973, p. 88.

⁴² "Bilan du PLAN CALCUL," 1966 - 1973, p. 87.

French computer industry, included numerous machines built under license from an American firm. French officials anticipated that the development of the new range P would take several years. To bridge the gap, government and industry officials continued marketing SEA's series 3900 and 4000, as well as to take advantage of the license agreement between CAE and SDS. From the CAE portfolio, CII adopted the scientific computer series 90, as well as series 10.000 which included the small computers 10.010 and 10.020 (industrial process control computers) and the 10.070, a larger machine, for scientific and management applications. All of these computers were manufactured under license from the American firm SDS. Available documentation gives no indication to what degree SEA, which had produced its computers independently from American firms, was opposed to this strategy.

Maurice Allegre who replaced Robert Galley as Délégué à l'informatique points out that "this may perhaps be a good tactic if one is conscious of the possibilities and one knowingly applies the principle: I copy first and I become independent after. But in this case, the risk is the application of another principle: I copy and in the end I will remain behind."⁴³ Whichever principle applied in the case of the Plan Calcul, it seems ironic that a plan that was intended to create a national computer industry free from American dominance got its start by manufacturing computers under American license. Perhaps the title of Jublin and Quatrepoint's book, French Ordinateurs, is most indicative of the oxymoron inherent in this concept.

⁴³ Jacques Jublin et Jean-Michel Quatrepoint, French Ordinateurs, p. 40.

Government influence was not limited to the creation of the industry itself; it also had a voice in the formulation of the commercial objectives of the company. The funding provided by government was limited and it was obvious from the outset that the firm could not produce a full range of computers. At the time, CII had three strategies to choose from. First, it could focus on building a supercomputer, which would allow access to the military market. A second option was to exploit niches where IBM had not yet penetrated. Or third, it could build a range of medium-sized computers, which would put CII in direct competition with IBM. Government officials and business representatives chose the third option. As laid out at the meeting of April 13, 1967,

efforts should be focussed on the development of a range of medium-sized computers. It would permit progressive but vigorous penetration of the principal sectors of the market in terms of scientific and industrial control applications, business and military applications. A special effort should be made in the domain of business computers because it offers the widest range of outlets.⁴⁴

Policy makers were of the opinion that small computers required mass production in order to be profitable. They rejected the option to build small computers because they believed that the demand for small computers was not adequate enough for the newly created firm to focus its production on small computers only. Large computers, on the other hand, required an expertise that French computer scientists were not yet able to provide. The result was a decision to limit development and manufacture to a range of medium-sized computers.⁴⁵

⁴⁴"Bilan du PLAN CALCUL," 1966 - 1973, p. 82.

⁴⁵"Bilan du PLAN CALCUL," 1966 - 1973, p. 83.

It is difficult to determine whether it would have been better for CII and the French government to have chosen one of the other two options to launch the French computer industry. It appears that the decision to develop medium-sized computers was based on the notion that this sector provided the greatest opportunity for a new firm entering the market. Policy makers were guided by motives different from industrialists and the biggest draw-back of the *Plan Calcul* was that it ignored the experience and the wishes of industry. For one thing, the objectives of the government did not necessarily coincide with those of industry. The objective of the French government was to achieve technological independence, and the computer industry became the instrument by which this independence was to be achieved. Yet if a firm is to survive in an international environment, it must have freedom to adapt its economic strategy as well as its product line. For a viable industry to develop, state security interests needed to be separated from the economic goals of the computer industry.⁴⁶

However, the goal of the French government was not simply to establish a computer firm, but to build an entire industrial sector to control the key developments of computer systems.⁴⁷ To become independent in all aspects of producing computers, French government officials also created SPERAC (*Systèmes et Périphériques Associés aux Calculateurs*) to produce peripherals. The firm “was set up as a joint subsidiary of

⁴⁶Zysman, “French Electronics Policy,” in Industrial Policies in Western Europe, p. 235.

⁴⁷ “Bilan du PLAN CALCUL, 1966-1973,” p. 79.

CDC (*Compagnie Des Compteurs*) and Thomson for the production of magnetic tape and disc drives, video monitors, displays and remote processing devices.”⁴⁸ It received 82 million FF in research and development funds and 18 million FF in loans.

A third firm, SECOSEM (*La Societe Europeenne de semi-conducteurs et de micro-electronique*), was created in 1968 to supply CII and SPERAC with components which, it was hoped, would stimulate the semi-conductor industry. This company received 85 million French Francs in research and development funds.⁴⁹ To be sure, the state watched closely over all proceedings, since it was the driving force behind the mergers, as well as the principal financier of the entire affair.⁵⁰

To be successful, CII would have required a world market share of approximately five per cent. However, as John Zysman pointed out in 1975, “[e]ven now CII does not control a much higher percentage of the French market - a market in its entirety little larger than 5 percent of the world market.”⁵¹ Indeed, in the late 1960s and early 1970s, CII could only survive with the help of massive state subsidies.⁵²

⁴⁸“Bilan du PLAN CALCUL,” 1966 - 1973, p. 89.

⁴⁹“Bilan du PLAN CALCUL,” 1966 - 1973, p.89.

⁵⁰Jean Michel-Quatrepoint et Jacques Jublin avec la collaboration de Danielle Arnaud, French Ordinateurs, p. 34.

⁵¹John Zysman, “French Electronics Policy,” in Industrial Policies in Western Europe, p. 241.

⁵²CII eventually became a partner in Unidata, a joint venture of Siemens, Philips (a dutch firm) and CII. Following the rupture of this undertaking in 1974-75, the French government engineered a merger between CII and Honeywell-Bull. Honeywell-Bull resulted from the sale of G.E.'s stake in Bull to the American firm Honeywell. At the time of the merger of CII with Honeywell-Bull, the French government arranged to take

Conclusion:

The French *Plan Calcul* was intended to achieve French technological independence as well as to restore French National pride after the government neglected to 'rescue' its champion firm, *les Machines Bull* in 1964.⁵³ French industrial policy was shaped by the French economic plan, the first of which was devised and implemented by Jean Monnet in 1946. Since then, economic planning has been a feature of the French political and economic landscape. Beginning in 1958, France joined the European Community which exposed its market to competition from other European countries, as well as to competition from American multinationals. The resulting fear of American economic and political domination, in particular in the computer industry, resulted in the formulation and implementation of the first *Plan Calcul* to create a national champion firm able to compete with American firms on a national as well as on an international level.

up a controlling interest in the new entity.

⁵³ Oral tradition among former *Bull* engineers maintains that de Gaulle's failure to rescue *Bull* was rooted in his displeasure regarding the company's activities during World War II.

Chapter 5:

A Comparison

Introduction:

After World War II, industrial policy emerged as an increasingly significant concern for governments. Prior to World War II, Western Europe, was seen by many as the centre of world economic power, and to protect national economies, individual states established tariff barriers. By the end of World War II, the centre of economic power had clearly shifted from Western Europe to the United States of America. The U.S. advocated an increase in free trade among the world's industrialized nations. The negotiations on the General Agreement on Tariffs and Trade (GATT), which began in 1947, were aimed at achieving this result.

The Technology Gap of the mid-1960s was a symptom of this shift in economic power and concomitant movement towards trade liberalization. Western European states, unable to keep pace with American economic development, in particular in the technology sector, sought to find solutions to this dilemma. The budding computer industry, in particular, was perceived to be vital to economic growth, and in order to protect national industries from American competition and the effects of trade liberalization, Western European states resorted to the implementation of industrial policies. This thesis traced the development and implementation of industrial policy in the domain of computers in France and West Germany in relation to the economic and political organization of the two countries.

As discussed in chapter 1, the Technology Gap was the result of economic and cultural differences between Western Europe and the U.S. As such it provided a pretext

for both countries to implement support programs; however, as we have seen, the programs developed by the two countries differed. This chapter will analyze these differences in greater detail. Such a comparison provides insight into how such programs reflect a country's political system and economic philosophies, but it may also answer questions as to why policy makers established the priorities they did.

Political and Economic Philosophy:

One of the fundamental differences between the two programs was a direct result of the political and economic organization of the two states. The West German program closely reflected the premises of federalism and of the Social Market Economy. The French *Plan Calcul*, on the other hand, was a direct result of French economic planning and reflected the central state structure and the nationalistic leadership style of General Charles de Gaulle.

As a federal state, West Germany developed new policies through a process of negotiation and compromise among the various stakeholders. This held true especially since the 'Grand Coalition', a coalition forged between the two largest political parties, assumed the political leadership of West Germany in late 1966. During the development phase of the federal support program for data processing, a rivalry emerged between the Minister of Scientific Research, Gerhard Stoltenberg, a member of the Christian Democrats, and the Minister of Economics, Karl Schiller, a Social Democrat. The two ministries avidly competed to take credit for this very important program. Eventually an agreement was reached that Gerhard Stoltenberg, Minister of Scientific Research, was to remain responsible for the entire program, while Karl Schiller, Minister of Economics,

was to provide low interest loans for the production of data processing systems to industry.

The German federal support program for data processing closely reflected the decentralized state structure of the Federal Republic. A very interesting point is that primary sources do not indicate either involvement or interference by the German Chancellor¹ in the development and implementation of the program. The German Federal Support Program was developed and implemented at the ministerial level in close cooperation with representatives from the computer industry. Aware that the Ministry of Scientific Research and the Ministry of Defence had vested interests in supporting the computer industry, representatives from the two largest computer firms lobbied federal bureaucrats and convinced them that the computer industry was vital to future economic growth. In order to develop the federal support program, the Ministry of Scientific Research needed to obtain consensus and support from other government departments to gain political support for this ambitious undertaking and to pass the required bill in the *Bundestag* in order to acquire funding. Thus, the decentralized structure of the federal support program was a direct result of political compromise and negotiation.

The French program, on the other hand, was developed within the context of the centralized state structure of the Fifth Republic, in which considerable power rested in the office of the President, General Charles de Gaulle. Although the president of *Les Machines Bull*, the flagship firm of the French computer industry until 1964, made the Prime Minister and the Finance Minister aware of the financial problems that the

¹ Ludwig Erhard, a Christian Democrat was Chancellor until the end of 1966. After the election of 1966, Kurt Georg Kiesinger, also a Christian Democrat, assumed the office of the Chancellor as the head of the Grand Coalition.

company was facing, the government's delayed reaction was too little, too late for the French firm. The French government bureaucracy was ready to rescue the French computer industry only after 51 percent of Bull had been bought up by the American firm G.E., and General Charles de Gaulle, decided that France needed its own computer industry in order to remain politically and economically independent from the U.S.

The French *Plan Calcul* also closely reflected the centralized state structure of France in that the development and implementation of the program was directed by the central government. Indeed, organizations such as the *Délégation à l'informatique* and *IRIA*, which were central to the *Plan Calcul*, reported directly to the Prime Minister. The French government also closely controlled the funding as well as product development for the three firms; and it mandated the mergers in order to create the firms it intended to subsidize. Furthermore, it left very little room for the three new companies to develop their own product lines and/or strategies to cope with American competition.

German policy makers justified the need for a Federal Support Program in the domain of data processing in relation to the fundamental premise of the Social Market Economy, which held that the government had to ensure competition within the market place. Industrial representatives sought government help based on the argument that U.S. firms, unlike their German counterparts, received extensive government support for R and D and, as a result, the competitive process in the international context was compromised. German industrial policy was developed with the intent to restore the competitiveness of German computer firms in the domestic and international market and to ensure that West Germany remained the second highest exporter of goods.

The Federal Support Program closely reflected the competitive aspect as laid out in the philosophy of the Social Market Economy itself. Government officials, with the aid of industry and the scientific community, developed an R and D program that would aid the computer industry in a way that preserved competition among German firms and also allowed individual firms significant latitude in their development programs. Theoretically, government support was available to all firms that were interested. Individual firms were required to submit proposals that would fit into the overall R and D plan. Members of an expert committee decided whether or not the proposed projects fit into the overall R and D plan and whether individual projects qualified for government support. Firms wishing to participate in the support program were required to provide fifty percent of the capital in order to receive government funding. Although the two largest firms, Siemens & Halske and AEG Telefunken, received the bulk of government funding, a number of smaller firms also benefited from the program.

The greatest disadvantage of the West German program was that it was extremely difficult to administer. The involvement of three government departments, the Ministry of Scientific Research, the Ministry of Defence (background only), and the Ministry of Economics made it difficult to ensure that firms were not double dipping, even though all programs were monitored by the Expert Council. The strength of the program was that its structure allowed the flexibility needed to adapt to the rapidly changing R and D environment and therefore to compete internationally.

The structure of the French Plan Calcul was closely tied to economic planning and a tendency toward direct government intervention. After failing to keep the French firm, *Bull*, under French control, French policy makers decided that no existing French

computer firm was big enough to compete against IBM in the international market. To remedy this problem, government created three firms, *CII*, *SESCOSEM* and *SPERAC*, to be the sole recipients of government funding through the Plan Calcul. Other existing French computer firms were, by default, excluded from any benefits that the government offered within the context of the *Plan Calcul*, therefore putting them at a great disadvantage in relation to the government sponsored firms. Keeping in line with economic planning, the government developed a five year plan in order to guide the development of computer technology.

The greatest problem for French policy makers was that the *Plan Calcul* was developed in response to a desire for technological independence and, as a result, it became closely intertwined with the political goals of the government. The greatest weakness of the plan was that it stifled competition among French computer firms. *CII* was the only computer firm that benefited from government support, putting other companies at a great disadvantage. Furthermore, being assured of government funding, *CII* lacked serious incentive to compete for a greater share in the international market.

The Military:

Another important difference between the two programs was that West Germany lacked a significant military establishment, in contrast to France. As we have seen in chapter I, military R and D in the U.S. was the driving force behind the development of computers. Both France and Germany spent considerably less on defence; however, as Table 8 shows, France spent about one third more on defence than Germany throughout the 1960s. To make up for this discrepancy, the Federal Support Program included a

Table 8: French and German Defence Expenditures

	France BiS	% of GNP	Germany BiS	% of GNP
1960	19.1	7.4	12.1	4.6
1961	20.3	7.3	13.1	4.6
1962	22.1	7.1	17.2	5.5
1963	22.8	6.5	19.9	6.0
1964	24.2	6.3	19.5	5.4
1965	25.3	6.1	19.9	5.0
1966	26.7	5.9	20.2	4.7
1967	28.9	5.9	21.4	5.0

component that provided funding for demonstration projects in eight different areas that facilitated R and D and served as a stimulus and as a market.

In France, the military establishment played a much larger role, although on a much smaller scale than in the U.S. Perhaps this is the reason why the French government did not feel the necessity to develop programs specifically aimed at computer utilization and application, thus focussing on a specific range of computers.

Program Structure Compared:

Both, the West German Federal Support Program and the French Plan Calcul aimed at competing with IBM where the American giant was at its strongest - in the manufacture of medium sized computers. German policy makers rejected the development of small computers because they felt that assistance in this area was not essential. French policy makers focused on medium sized computers because they expected to be most successful technologically and commercially in this area.

Yet it is interesting to see how economic and political priorities of each government translated this shared technological focus into two very different programs.

The various political and economic interests in West Germany culminated in a program at the centre of which was an expert committee composed of scientists who provided advice to the Ministry of Scientific Research. The program itself was structured so that several firms could benefit from government funding without compromising competition. Policy makers and industrialists refrained from focusing on producing a specific range of computers; instead, the German program was structured in a way that allowed the various firms to continue working on projects that were underway prior to the support program. A minimum of business disruption was thus ensured.

The program itself was divided into three main funding areas, with the largest portion, allocated for future oriented R and D, consisting of eight research areas. The West German federal government provided approximately 230 million DM for this aspect of the program. In addition, individual firms provided fifty per cent of the cost of individual projects, bringing the total available for future oriented R and D to approximately 460 million DM. An additional thirty million DM was provided for the GMD to stem the brain drain, while another 20 million DM was allocated toward demonstration projects within the federal public service in order to provide a market for computer systems. Furthermore, the Ministry of economics provided 115 million DM to the German data processing industry. Taking all these support measures into consideration, the German Federal Support Program for Data Processing was substantial. The German data processing industry had a large stake in the success of the program because it assumed a large share of the cost (approximately 230 million DM) of developing and marketing data processing systems.

The structure of the French program was also divided into three components. In contrast to the German program, which was divided along research areas, the French program was divided along production lines. The French government provided the largest amount of money, 351 million French Francs, for the development and production of the two computer ranges, Gamme 1 and Gamme 2. Since the latter range was to be developed in the future, the *Plan Calcul* provided only 41 million FF for Gamme 2, as opposed to 310 million FF for Gamme 1. One possible reason for this may be that French policy makers sought an immediate solution to the problem of American domination. They based their decision on the fact that several models from Gamme 1 remained successful in the market for longer than anticipated, but failed to see the importance of keeping several years abreast in R and D in the domain of computers. An additional 61 million French Francs was provided to support the two firms that produced components (SESCOSEM) and peripherals (SPERAC), bringing the total to 411 million French Francs.

It is not clear from the documentation whether the French firm CII contributed in any way toward the program, but it appears as if the major financial stimulus came from the government. French policy makers closely guided industrial policy in France, leaving the three firms it supported (CII, SPERAC and SESCOSEM) little of the flexibility needed to compete in an international environment.

The greatest difference between the two programs should be ascribed to the relationship between government, industry and the scientific community. In developing the federal support program, West German policy makers closely cooperated with industrial representatives as well as with the scientific community. The documentation is

not explicit to what degree French policy makers involved the scientific community in the development of the *Plan Calcul*, but the structure of the plan gave French industry very little input into the development and implementation of industrial policy. For example, the merger that the French government mandated in order to create CII was not welcomed by the companies involved.

Successes and Failures:

In terms of success the West German firm, Siemens & Halske fared slightly better than the French firm CII. Siemens reported a loss of \$20 to \$30 million for its data processing division. This substantive loss may be explained by the fact that a large percentage of the firm's computer systems were leased, which meant that the firm would recover its costs in future years. However, the data processing division of Siemens & Halske was expected to break even by 1972.² CII broke even for the first time in 1970. In 1971, it reported a profit of one million dollars and a two to three million dollar profit was projected for 1972. However, these calculations included the contributions under the Plan Calcul, which amounted to \$20 million a year. Excluding the subsidy, CII was in the red for several more years.³

The success of the two programs can also be measured in terms of revenues and market shares. Throughout the duration of the program, the revenues of Siemens & Halske and CII rose steadily. In 1966, the data processing division of Siemens & Halske

² 30-2119-100S "A Study of Selected Computer Manufacturers," Siemens & Halske, p. 31.

³ 30-2119-100C "A Study of Selected Computer Manufacturers," CII, p. 12.

reported a revenue of \$16 million, which rose to \$40 million in 1969 and to \$300 million in 1972. In 1967, CII reported a revenue of \$47.4 million and \$162.8 million in 1972.⁴

The two firms also increased their market share by a considerable margin. In 1967 Siemens & Halske held four percent of the German data processing market,⁵ by 1969, the share had increased to 13 percent and by 1972, Siemens & Halske controlled 20 percent of Germany's data processing sector, which, at that time, had reached a total value of four billion dollars.⁶ CII as well saw its market share increase. In 1969, CII controlled five percent of the French data processing market. By 1969 it had increased its share to seven percent of the market, which had reached a value of \$2.65 billion by 1972. In addition, CII managed to capture two percent of the international market.⁷

Other aspects of success, such as for example the training and education of the work force are much more difficult to quantify. Both support programs provided for support to stem the brain drain; however, it is very difficult to measure the success of these initiatives. It should be noted that although many scientists and engineers left Western Europe in the early 1960s, many of them may have returned to Western Europe once additional opportunities were created through the implementation of government support programs. Data to this effect could not be located; however, one can only speculate that with the growing opportunities in Western Europe, the brain drain was at least slowed.

⁴ 55-116-32 Arthur Little, "World Computer Industry 1973-78", p. 12.

⁵ OECD, Gaps in Technology; Electronic Computers, p. 163.

⁶ 2119-100S "A Study of Selected Computer Manufacturers," Siemens & Halske, p viii.

Although it appears that neither the German Federal Support Program nor the Plan Calcul was an unmitigated success, it was the German firm Siemens & Halske that showed promise in the long-term. By 1975 the firm had become the largest computer manufacturer in Western Europe, while the French firm CII still depended heavily on government support for its survival.

Conclusion:

The technology gap of the 1960s provided a great opportunity to explore, contrast and compare how West Germany and France responded with national programs. Based on government records, this thesis confirms the general view that individual countries develop unique industrial policies based on their political and economic cultures. In this case the two countries responded to the same phenomenon; however, the resulting industrial programs differed fundamentally from each other. The German Federal Support Program for Data Processing was greatly influenced by the social market philosophy as well as by the federal state structure. The French program, on the other hand, was shaped by economic planning and the central structure of the French state. While the basis of the German program was a competitive selection process where the firms were requested to submit proposals in order to be considered for funding, the French government provided financial support to a single computer firm which it had forged through a merger.

⁷ Information in this paragraph is based on Arthur Little, "World Computer Industry 1973-78", p. 16-22.

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