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**Spatial Analysis, Industry  
and the Industrial Environment**  
*Progress in Research and Applications*

Volume I

**Industrial Systems**



*Edited by*

**F. E. Ian Hamilton**

*Lecturer in Social Studies,  
London School of Economics and Political Science  
and School of Slavonic and East European Studies,  
University of London*

*and*

**G. J. R. Linge**

*Professorial Fellow, Department of Human Geography,  
Research School of Pacific Studies,  
The Australian National University, Canberra, Australia*



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# **Industrial Systems**

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# Contributors

Neil M. M. Dorward, B.Sc. (Econ.), Ph.D. (London) is currently Principal Lecturer in Business Studies at the Polytechnic of North London following ten years at the City of London Polytechnic, England.

Carl G. Fredriksson, M.B.A., Ph.D. (Umeå) is working now for the Swedish Ministry of Industry in Stockholm after teaching in Business Administration at the University of Umea, Sweden.

Aleksandr P. Gorkin, B.A., candidate of geographic science (Moscow) is a Senior Research Worker in the Institute of Geography, Soviet Academy of Sciences, Moscow.

Lars Hakånson, B.Sc. (Econ.) is Lecturer in Geography, Stockholm School of Economics and also a consultant to The National Swedish Industrial Board.

F. E. Ian Hamilton, B.Sc. (Econ.), Ph.D. (London) is a Lecturer in Social Studies in the University of London and Chairman of the International Geographical Union Commission on Industrial Systems.

Peggy A. Lentz, B.A. (Syracuse), M.A., Ph.D. (Clark) is Associate Professor of Urban and Regional Planning, Urban Studies Institute, University of New Orleans and currently a visiting Scholar, Office of Policy Development and Research, United States Department of Housing and Urban Development.

William F. Lever, M.A., D.Phil. (Oxon) is Senior Lecturer in Urban Studies in the Departments of Social and Economic Research and Architecture at Glasgow University, Scotland.

Leif G. Lindmark, M.B.A., Ph.D. (Umeå) is Assistant Professor in Business Administration at the University of Umeå, Sweden.

Godfrey J. R. Linge, B.Sc. (Econ.) London, Ph.D. (New Zealand) is Professorial Fellow, Department of Human Geography, Research School of Pacific Studies, The Australian National University, Canberra, Australia.

Doreen Massey, B.A. (Oxon), Ph.D. (University of Pennsylvania) is at present Principal Scientific Officer with the Centre for Environmental Studies, London.

Jan-Evert Nilsson, M.B.A., Ph.D. (Umeå) is currently Research Associate at the

Resource Policy Group, Oslo, Norway and formerly Lecturer in Business Administration in the University of Umeå, Sweden.

Leonid V. Smirnyagin, B.A., candidate of geographic science (Moscow) is a Senior Lecturer of the Geography Faculty of the M.V. Lomonosov Moscow State University, U.S.S.R.

David M. Smith, B.A., Ph.D. (Nottingham) is Professor of Geography at Queen Mary College, University of London.

H. Wade VanLandingham, B.A. (Florida), M.U.R.P. (New Orleans) is Research Associate in the Urban Studies Institute, University of New Orleans, U.S.A.

David A. Wadley, B.A. (Sydney), Ph.D. (A.N.U.), formerly teaching in the University of Melbourne is now Lecturer in Economic Geography, University of Queensland, Brisbane, Australia.

## Editors' Preface

This is the first volume in a new series which sets out to debate and to disseminate progress in research and applications in a broad field entitled 'spatial analysis, industry, and the industrial environment'. Some papers will, of course, be concerned with location theory and practice, techniques of analysis and measurement, industrial production systems and linkages, and will present case studies of specific industries, organizations, and regions. But others will go beyond the 'traditional' preserve of industrial geography and will investigate the patterns, processes, and impacts of evolution, changes in industry and industrial organization, and the complexities of the multifaceted relationships with the broad environment within which industry operates. Manufacturing is treated as a pivotal object of study and applications, as a major recipient of 'inputs' or 'influences' from the environment and as a key source of 'outputs' to or 'effects' on the environment. Whether it be economic, commercial, governmental, political, or social, or local, urban, regional, or national, environment has itself a spatial structure shaping and, in turn, being shaped by world manufacturing. Thus papers in these volumes will expound theories, concepts, methods, techniques, and case studies regarding the spatial structure of industry, industry-related activities and their environments: they will not only be concerned to synthesize and re-evaluate past and present frontiers but to suggest fruitful avenues for future research and policy applications.

An important object of this series will be to encourage contributions from people working on 'industry-space' problems in countries having differing political philosophies and being at various stages of 'development'. It is not unfair to suggest that in the English-speaking world much of the evolving body of location theory has been narrowly conceived in terms of managerially and technologically sophisticated firms operating in capitalist or mixed economies. But the reality is that by no means all manufacturing activities in the world take place under these conditions. Moreover, the rapid industrialization of the developing countries (see Chapter 1) provides new challenges for those concerned with location theory and practice but as yet these have hardly been recognized, much less accepted. Editorially, then, every effort will be made to draw on work from a wide range of sources, to disseminate research and policy results from diversified experience and to facilitate cross-cultural comparison.

This volume, *Industrial Systems*, also indicates another intention of the editors. Rather than publishing disparate research papers in the spirit of most scientific journals or of volumes reviewing progress in a certain well-defined field, each book will contain a group of contributions focusing on a particular theme or problem. Depending on the subject, it may sometimes be appropriate (as in this

present book) to have a fairly wide-ranging set of contributions to illustrate the diversity of approaches; on other occasions it may be more appropriate to explore a problem by means of a tightly structured group of papers. However, this approach does not preclude the publication in each book of other high-quality papers on any topics relevant to the series: indeed the editors welcome offers of such contributions.

Through several of its chapters, therefore, *Industrial Systems* sets out to initiate a 'new look' at the industrial sphere by examining its structure and some of its components from a systems viewpoint. Overall, the chapters are ordered from the more conceptual to the more empirical, but broadly the idea of an industrial system and its subsystems operating in an environment threads them together. Clearly no part of the system and its environment can be treated in isolation: all parts interact with all other parts.

The editors in Chapter 1 set out to define the salient features of the world industrial system, illustrating their argument by reference to similarities and differences between the capitalist and socialist industrial systems, a theme which is also taken up, from a Soviet viewpoint, by Gorkin and Smirnyagin in Chapter 2. However, Hamilton and Linge also refer to the increasing scales and complexities of interdependence both within and between industrial places in advanced capitalist and developed socialist economies and also between them and the developing economies. In Chapter 3, Smith builds upon the fairly extensive re-examination of location theory that has been accomplished in recent years to cast the spatial modelling of industrial systems into a broader conceptual framework which incorporates welfare criteria. Massey lends further support in Chapter 4 to a structural approach to the understanding of spatial patterns of industry under capitalism in her critical review of the 'state of the art'.

The middle chapters of the book examine distinctive aspects of the interaction between industry and its environment. Lentz and VanLandingham discuss in Chapter 5 aspects of the interrelationships between energy supply, industrialization, and regional economic growth by reference to Louisiana in the American 'Sun Belt'. In Chapter 6, Lever outlines the spatial pattern of labour markets in Great Britain and examines, in particular, industrial influence on the environment in the form of the domination of local labour markets by certain industries and industrial organizations.

Then follows a group of Chapters (7–9) which contain other common links. Written by Scandinavians, drawing largely on the experience of their own part of the developed world, they all adopt something of an historical perspective, examining the evolution of industrial organization, structure, and space economy. Each points to important, yet changing, regional, interregional, or international interdependencies in that evolution, so emphasizing the significance of links between evolving industrial systems and various levels of the spatial hierarchy. In Chapter 7 Håkanson conceptualizes the spatial pattern and process of corporate growth from a modest one-plant firm to a large transnational

organization. Nilsson in Chapter 8 uses Swedish Norrland as a laboratory in which to investigate changes in industrial structure, location, regional development, and the consequent interregional linkages. Chapter 9, by Fredriksson and Lindmark, elaborates on the progression of interregional interdependencies that result as firms evolve into systems of firms.

The last two chapters focus upon examples of particular engineering industries in two contrasting national economic environments to illustrate a neglected field of analysis: the interaction of the marketing of industrial products and the spatial pattern of production itself. In Chapter 10 Wadley examines the role of wholesaling by reference to the Australian farm machinery industry and emphasizes the importance of analysing industrial activity under conditions of diminishing, not growing, market opportunities. Finally, in Chapter 11, Dorward studies the impact of marketing strategy and product differentiation upon growth and spatial change in the truck industry in the German Federal Republic.

All references have been amalgamated into a single list at the end of the book. Not only is this convenient for users, but it is believed that such an arrangement will, during the course of this series, make the bibliography itself a useful and continuing source of information about the literature available in this general field.

F. E. Ian Hamilton,  
*London, England.*

G. J. R. Linge,  
*Canberra, Australia.*

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# Chapter 1

## Industrial Systems



F. E. IAN HAMILTON AND G. J. R. LINGE

Exposure to quantification, computer logic, and the techniques of the natural sciences has led geographers in recent years to seek more rigorous intellectual frameworks in which to develop general models of spatial behavior. Although there are some notable exceptions, it is perhaps not unfair to suggest that much of the research in industrial geography has been concerned with individual and unrelated case studies which—though admirable in themselves—yield both low order descriptive and classificatory propositions about the real world and somewhat vague generalizations with poor predictive powers. To try to improve this situation, the view that a systems approach has much to offer social scientists gained impetus during the 1960s (Haggett, 1965; Harvey, 1969). Yet only now is this attracting the attention of industrial and economic geographers who, increasingly, are appreciating that changes taking place to the organization of industry in one particular area have repercussions for the other areas with which it has direct and indirect linkages. Formal recognition of the appropriateness of this approach came from the International Geographical Union in 1976 when it established a Commission on Industrial Systems with the task of advancing the conceptual and theoretical understanding of the spatial distribution and interdependence of industrial activities. From such a stimulus, this chapter reviews some aspects of the nature and functioning of industrial systems and attempts to provide some elements of a framework for future research in this field. In particular it draws attention to the similarities and differences between the operations of industrial systems in capitalist and socialist economies and the ways in which these relate to each other and to the global system of which they are part.

### DEFINITIONS

At the outset it is important to clarify the meanings attached here to the words 'industrial organization', 'industry', and 'system'.

#### *Industrial Organization*

The term 'industrial organization' describes any administrative-managerial structure responsible for planning, policy-making, administering and operating one or more industrial units. It thus embraces a variety of situations:

- (a) a capitalist firm of any size or form which is independent;

(b) a capitalist corporation controlling subsidiary firms (e.g. Nestlé Alimentana S.A. of Switzerland which has 198 factories of which only 4 are in its home market);

(c) a state-owned nationalized industrial board or agency (such as the British Steel Corporation or British Shipbuilders in the United Kingdom) in a 'mixed economy' (a term denoting direct state intervention to ameliorate, but not to replace, a capitalist economic system);

(d) a central government ministry or agency in a socialist country with responsibility for running an entire industry (e.g. the Ministry of the Automobile Industry of the Soviet Union—*Ministerstvo Avtomobil'noy Promyshlennosti SSSR*);

(e) a republic or regional industry ministry or directorate such as the Ministry of the Food Industries of the Russian Soviet Federated Socialist Republic (*Ministerstvo Pishchevoy Promyshlennosti RSFSR*), or a regional association of industrial enterprises in a socialist country, such as the Kharkov Industrial Equipment Union, called *Soyuztekhnosnastka*.

In many industrial organizations sections of the administrative-managerial structure are spatially separated. For example, the head office of a typical transnational corporation based in the United States concentrates on devising and supervising world-wide strategy, and delegates some of its authority through a hierarchy of regional, national, and operating unit managements located in perhaps 50 or 60 countries.

### *Industry*

In many languages the equivalent word to 'industry' is used unambiguously to mean factory activity in which materials are processed or transformed by mechanical or chemical means into more valuable products. In English-speaking countries, however, the word *industry* is used more loosely in such phrases as 'the dairy industry' to mean simply dairy farming, or 'the tourist industry' to embrace the wide array of activities concerned with the organization, transport, accommodation, and entertainment of tourists. Ironically, this less precise usage (or abuse) has led many social scientists to avoid the word *industry* unless modified as in 'manufacturing industry' or to turn instead to the word 'manufacturing' (as in 'manufacturing sector'). The irony arises because the word 'manufacture'—stemming from Latin and French roots—literally means 'to make by hand' which is, of course, the reverse of the meaning now intended.

But even if the words 'industry' and 'manufacturing' are both understood to include activities carried on in operating units—such as factories and plants—other definitional problems remain. One of these is the extent to which small-scale 'workshop' activities should be included in analyses of industrial systems in advanced and developing societies (Hamilton, 1978a). In Australia, for instance,

27 per cent of all factories (excluding places simply engaged in repair work) have fewer than 4 workers but these occupy less than 2 per cent of the manufacturing labour force and contribute less than 1 per cent to the value added by the manufacturing sector. In developed societies small establishments tend to be numerically more important in certain kinds of activities (such as printing and instrument-making) but in all industries they make up an important part of the complex production chain or network through which inputs are transformed into more valuable outputs. Moreover, small industrial organizations form part of the life cycle of manufacturing enterprise, some of the world's largest corporations having emerged from very modest origins (Edwards and Townsend, 1961; Jewkes *et al.*, 1961). In developing societies, small-scale workshops are important culturally and socially. Thus in Melanesia they enable completely new skills (such as welding) to be diffused into remote areas; in South-East Asian countries, family workshops provide employment opportunities for elderly and handicapped relatives who might otherwise have no means of support. In various ways, then, small-scale establishments form an integral part of the evolution and operation of industrial systems so that distinctions between 'manufacturing industry' and 'workshop industry'—perhaps using measures like floorspace per worker, energy consumption, or fixed tangible assets—would be both artificial and arbitrary. In practice, however, such distinctions are often taken out of the hands of social scientists who for the most part have to rely on data collected by official agencies.

Another major definitional problem arises because of uncertainty about what activities should be treated as part of the industry sector on the one hand, or as part of the general environment in which industry operates on the other. It is convenient to divide such activities into those that take place *prior* to the manufacturing stage and those that occur *during* and *after* this stage.

(a) *Activities preceding manufacturing* The industry sector—directly or indirectly—depends on supplies of raw materials from fishing, farming, grazing, mining, and forestry operations. The relationship may be very close (both spatially and entrepreneurially) as is often the case, for example, in sugar milling, fruit canning, forest sawmilling, and brickmaking when the crops, trees, and minerals are produced and processed in an integrated operation. Then there are instances where the production of the raw materials is spatially separate from the processing operation even though both are controlled by the same management: this is true of aluminium smelting plants in Europe which draw on alumina produced in refineries operating elsewhere in the world as part of the same transnational corporation. Finally there are industrial organizations that have no spatial or entrepreneurial connection with the firms supplying them with raw materials. No one completely satisfactory line can be drawn but basically the production of raw materials that pass into the manufacturing sector should probably be regarded as industry-related activities rather than as industrial

activities in themselves. Again, in reality, the social scientist sometimes has little choice but to accept the inter-sectoral divisions used in official statistical publications which, increasingly, are adopting recommendations of international bodies such as those associated with the United Nations. For example, in several countries the extraction of a raw material is included within the definition of industry only if it forms an integral part of the operations of a manufacturing establishment at a single physical location and if the gross value of the extractive operation does not exceed a fairly modest specified value.

(b) *Activities during manufacturing* There is little need to debate the view that people engaged in managerial and administrative functions associated with an industrial unit (including those in a separately located head office) should be regarded as part of the manufacturing workforce. The 'white collar' personnel of a factory enterprise in a capitalist society or in the private (capitalist) sector of a mixed economy are, clearly, part of the industry. To be consistent, the officials administering state-owned industries or industrial units in a mixed economy and the staff of the ministerial-level organizations responsible for the various branches of manufacturing activity in a socialist economy should also be regarded as part of industry. A clear distinction must be drawn, however, between bureaucrats *directly* involved in industry decision-making and those that influence the behaviour of industrial organizations—whether these be capitalist, socialist, or government-owned—through their management of such matters as prices, tariffs and taxes, or of planning, all of which form part of the general environment in which industry (and other activity) must operate.

(c) *Activities following manufacturing* There are problems, too, about whether some activities that follow the actual processing/production stage should be included within industry. For example, some industrial organizations, such as those operating petroleum refineries, run large-scale, multimodal transport operations, and almost every operating unit has at least some investment in delivery vans and trucks. As a further instance, some industrial organizations are closely related to marketing enterprises that act as their wholesale or retail distributors and provide after-sales servicing of their products. Some of these are directly owned and managed by capitalist industrial firms or form part of socialist enterprises administered by a ministerial-level organization or a self-management board. As a case in point, a chain of shops selling men's suits in the United Kingdom has used the slogan 'from weaver to wearer' to publicize the close association between its production and retailing operations. Others are separately owned, financed and managed firms and enterprises which are associated by various arrangements—such as franchise agreements (see Wadley: Chapter 10)—to particular industrial concerns. In Yugoslavia enterprises manufacturing textiles, shoes, confectionery, and other consumer products maintain their own outlets up and down the country, but in other socialist

economies centralized trading agencies distribute goods from several or all producers to each marketing outlet. In general it seems appropriate to regard these as industry-related activities rather than ones that should be included within the industry sector itself. In practice in several countries the official statistics allocate to the industrial sector only those selling activities that take place at the factory concerned, such as timber sold at a sawmill, cloth at a textile plant, and butter or cheese at a dairy factory.

It would seem useful, then, to treat organizations as belonging to one of three categories:

(a) *industry*, being activities wholly or dominantly concerned with the processing of materials by physical or chemical means into more valuable products;

(b) *industry-related*, being non-industrial as an activity in itself but closely linked to those that are;

(c) *industry-environmental*, being activities that do not fall into the previous categories but that help shape the environment within which industry operates.

Having said this it must be noted, however, that in socialist countries the term 'industry' is used in its economic and planning aspects to embrace

a sector of the economy concerned with the extraction of natural resources (e.g. all branches of mining) and with the processing of raw materials also containing human labour, and of semi-finished products (manufacturing industry). It also includes certain industrial services (public utilities such as electricity, gas and thermal heating systems, as well as repair and maintenance services). In its practical sense, industry is to be understood as the operation of industrial organizations, primarily economic units performing industrial activity (Bora, 1977, p. 1).

### *Systems*

This definitional discussion illustrates that industry does not operate in isolation but rather as part of a very much more complex arrangement, or 'system', of activities. The relevance, application, and complexity of a systems approach to geographical enquiry has been examined by, among others, Chisholm (1967) and Walmsley (1972). Here it is sufficient to note that a system consists of a set of 'actors' that (a) functions together, (b) through various types, degrees, and directions of linkages, demands outputs from and supplies inputs to other actors, and (c) behaves in particular ways as a result of interactions between either the whole set of actors or between certain groupings of them on the one hand, and the 'environment' on the other. The acknowledgement of the existence of an external environment is a recognition that the system itself is not closed and that, although cohesive and interdependent as a whole, it comprises subsets of actors which to a greater or lesser extent interact with the external environment.