

Innovation Diffusion: Retrospect and Prospect

Lawrence A. Brown*

Contents

- | | |
|---|---|
| 1. Definition and Scope of Innovation Diffusion | 3. Innovation Diffusion: A Prospective View |
| 2. Innovation Diffusion: A Retrospective View | (1) Consumer Innovations and Application of the Market and Infrastructure Perspective |
| (1) The Cultural Geography Tradition | (2) The Diffusion of Development in Third World Settings |
| (2) The Hagerstrand Tradition | (3) Technological Innovations and Regional Differences in Their Occurrence |
| (3) The Market and Infrastructure Perspective | 4. Summary Statement |

Innovation diffusion has been a major theme of geographic research for most of the 20th century. This theme was initially elaborated in broad terms concerning cultural change overall; later it took a more narrow focus on particular innovations; presently, broad themes are once more emerging.

This paper reviews these shifts under four major headings. First, the Definition and Scope of Innovation Diffusion is outlined. Second, previous research is summarized in the section Innovation Diffusion: A Retrospective View. Third, present research trends are summarized in the section Innovation Diffusion: A Prospective View. The paper concludes with a Summary Statement. It should be noted that material presented here is chosen selectively to elaborate broad themes perceived by the author; an exhaustive review has not been attempted.

1. Definition and Scope of Innovation Diffusion

Diffusion refers to a process of spread from one locale to another, one social group to another, or one person to another. Hence, the spatial distribution of an innovation changes over time; that is, maps showing the locations of an innovation differ from time 1 to time 2.

An innovation may be a new product, new technique, new practice, or a new idea. An innovation also may be a collection or composite of specific items; examples are green revolution agriculture (the elements of which include high yielding variety seeds, fertilizer, and irrigation), regional development/modernization, or contemporary production processes such as flexible manufacturing systems.

An innovation is new to the society being considered; Korean or Japanese restaurants, for

* Professor, Department of Geography, Ohio State University, USA. Editorial and technical assistance was provided by Wookung Huh, Byong Min Lee, and Sam Ock Park of Seoul National University; also by Linda Lobao, Rodrigo Sierra, and Randy Smith of Ohio State University. Their contributions are appreciated. An earlier version of this paper was presented at the June 1990 meeting of the Korean Geographical Society.

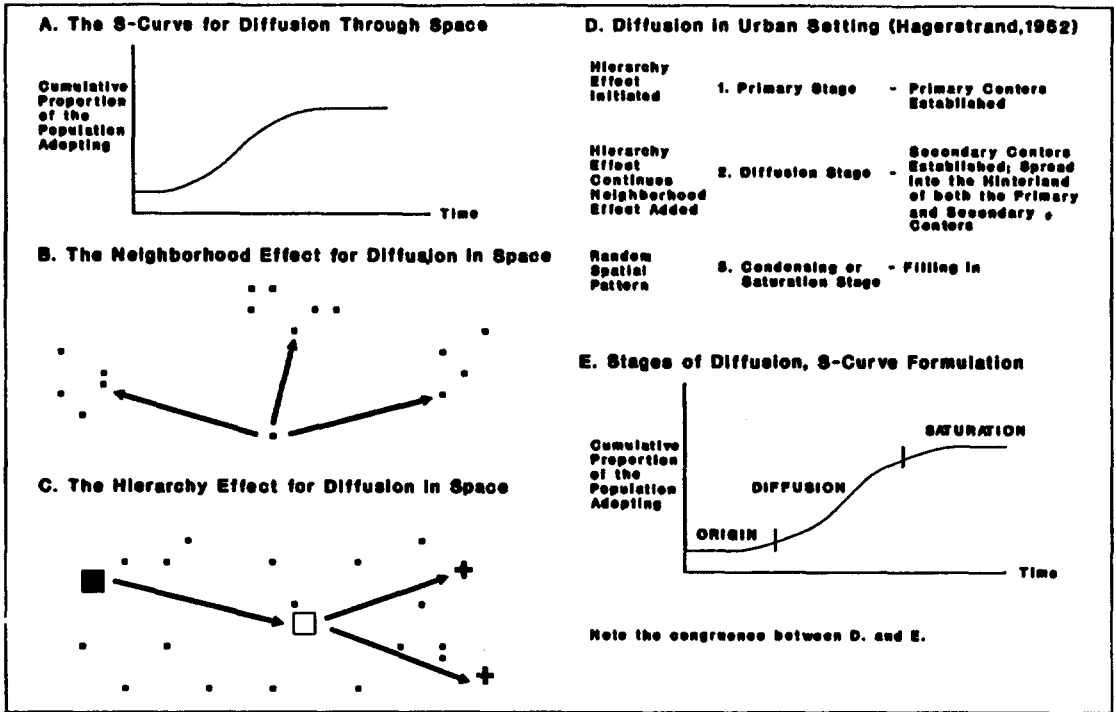


Figure 1. Empirical Regularities Diffusion

example, are commonplace in those countries but an innovation in United States dining! Hence, an innovation in one place may not be an innovation in another; and innovations are not necessarily new in an absolute sense.

Innovations are often divided into consumer innovations and firm or technological innovations. Consumer innovations are used as a final product and adopted by individuals or households; compact disk recording systems are an example. Firm/technological innovations are used in production processes and adopted by economic entities; flexible manufacturing, computer assisted design (CAD), and electronic funds transfer (bank) systems are examples. These categories are not mutually exclusive, however. A personal computer, for example, may be used either as a consumer or technological innovation. And agricultural innovations are

used in a production process, but the economic entity adopting them often is a household.

The study of consumer and firm/technological innovations generally has proceeded along different lines, and taken different approaches.

Finally, it should be noted that innovation diffusion is an interdisciplinary topic studied, at the very least, in Anthropology, Economics, Geography, Marketing, Political Science, Psychology, and Sociology.

2. Innovation Diffusion: A Retrospective View

It is convenient to divide earlier research on innovation diffusion into two phases. The earlier phase is represented here as the Cultural Geography and Hagerstrand Traditions; the later phase as the Market and Infrastructure Perspective.¹⁾

1) A detailed discussion overviewing diffusion research in Geography up to 1981, including coverage of the

(1) The Cultural Geography Tradition

This work, which interfaces with Anthropological concerns, focusses on the question whether evolution or diffusion is at the root of culture formation. Carl Sauer and the Berkeley School are most commonly identified with the Cultural Geography Tradition.

A major research focus is the diffusion of culture traits, which are seen as indices of a specific culture. Hence, the spread of specific traits indicates how the culture itself spread and affected other cultures. Chang's study of Korean folk houses is an example of work in this genre.²⁾

(2) The Hagerstrand Tradition

One component of the Hagerstrand tradition is descriptive studies that focus on diffusion patterns. Initially, these were methodologically and intellectually linked with the examination of culture traits, but the object of study was contemporary, rather than historical, phenomena. An example is Hagerstrand's investigation of the spread of the motor car in Southern Sweden.³⁾ Eventually, the pattern of diffusion became a topic in its own right as evidenced by discourses on empirical regularities therein (Figure 1). A comprehensive discussion of such regularities is provided by Brown and Cox.⁴⁾ Examples where analyses of diffusion patterns play a prominent role include S.B. Park's study of the diffusion

of radio and television receivers in Korea and Brown's studies of the spread of cable television in Ohio (Chapter 3), Planned Parenthood affiliates in the United States (Chapter 3), and agricultural innovations in Kenya and Mexico (Chapter 7).⁵⁾

A second component of the Hagerstrand tradition is mathematical modeling, using simulation techniques, to account for diffusion of agricultural innovations across a landscape on the basis of information flows (contacts) between people. In the 1960s/70s this had major impacts on Geography and other social sciences concerned with mathematical modeling. Korean applications of the Hagerstrand's model are provided by Huh's study of the diffusion of Ginseng cultivation and J.R. Lee's study of the diffusion of family planning in Nasan Province.⁶⁾

Finally, the Hagerstrand tradition emphasized the theme of conceptualizing, or explaining, the process of innovation diffusion. Hagerstrand's conceptualization focused on adoption of the innovation and saw this as the outcome of a communications process wherein interpersonal contacts were especially important (Figure 2). In this spirit, Hagerstrand addressed what Brown terms the Adoption Perspective, or demand-side, of innovation diffusion; a perspective that was characteristic of all social scientists studying innovation diffusion at the time.⁷⁾ J.R. Lee's study of the diffusion of vegetable production

Cultural Geography, Hagerstrand, and Market and Infrastructure perspectives, can be found in Chapter 2 of Brown, L.A., 1981, *Innovation Diffusion: A New Perspective*, Methuen (now Routledge), London and New York. Also relevant is Sugiura's study of several diffusions in Japan; see Sugiura, Y., 1985, 'Spatial diffusion of innovations,' *Geographical Reports of Tokyo Metropolitan University*, 20, 121-178.

2) Chang, B.W., 1981, *A Cultural Geographical Study of Folk Houses in Korea*, Pochincha Publishing, Seoul.

3) Hagerstrand, T., 1952, *The Propagation of Innovation Waves*, Gleerup, Lund Studies in Geography B-4, Lund, Sweden.

4) Brown, L.A. and Cox, K.R., 1971, 'Empirical regularities in the diffusion of innovation,' *Annals of the Association of American Geographers*, 61, 551-559.

5) Park, S.B., 1977, 'The spatial diffusion of mass media in Korea, 1945-1977,' *Geography*, 16, 55-77. Brown, 1981, *op. cit.*

6) Huh, W., 1976, 'Spatial diffusion of ginseng (insam) as an innovation diffusion,' *Chongju Women's College of Education Thesis Collection*, 5, 33-57.

Lee, J.R., 1987, 'A study on the spatial diffusion of family planning innovation in Nasan Province,' *The Geographical Journal of Korea*, 12, 193-220.

7) Brown, 1981, *op. cit.*

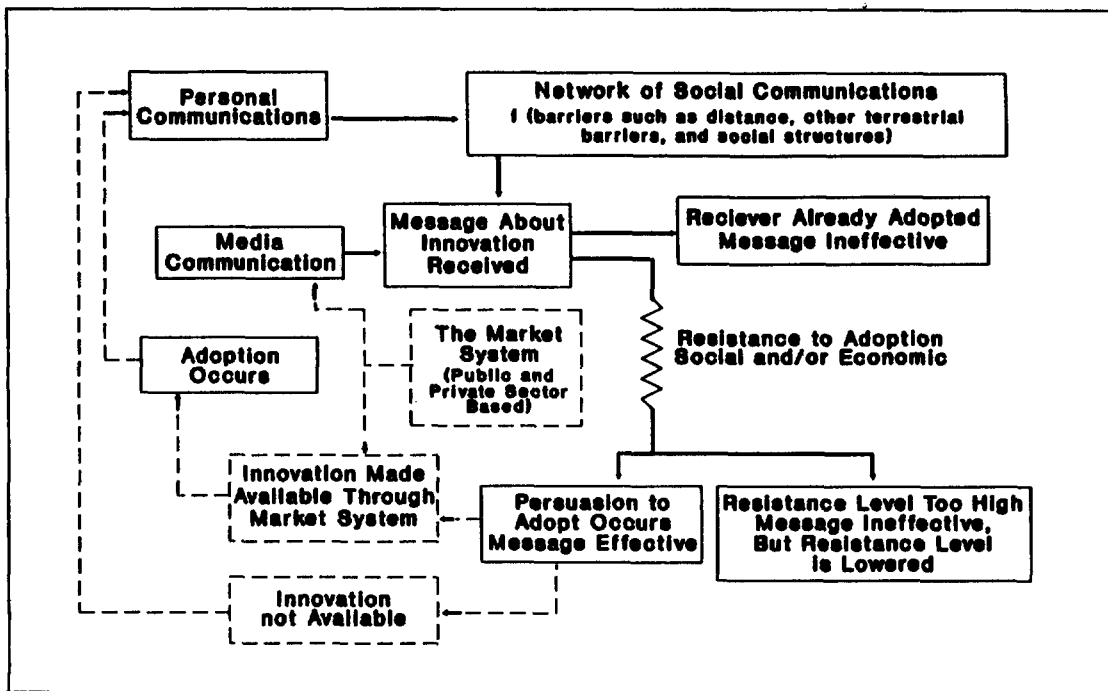


Figure 2. A Flow Diagram of the Adoption Perspective on Innovation Diffusion(Hagerstrand) with Modifications Reflecting the Market and Infrastructure Perspective*

* Dotted lines and boxes indicate aspects of the Market and Infrastructure Perspective

among farmers in the Kwangju hinterland provides a Korean example, as does C.S. Park's (1981) study of rototillers.⁸⁾

(3) The Market and Infrastructure Perspective

This framework, which is most completely articulated in Brown's *Innovation Diffusion: A New Perspective*, represents a distinct departure from earlier approaches.⁹⁾ It complements the adoption perspective of Hagerstrand and other social scientists by focussing on the supply or availability of innovations (Figure 2). Brown argues

- That the broad outlines of innovation diffusion patterns are shaped by where the innovation is available;

- That, within those broad outlines, more detailed variations in innovation diffusion patterns is determined by adoption behavior.

Important components that determine where an innovation is available, and the overall pattern of diffusion, include

- The propagator of the innovation (for example, an automobile manufacturer or fast food service corporation);
- The diffusion agency through which the innovation is distributed to the market (for example, retail outlets such as an automobile showroom, fast food restaurant, or shopping center);
- The diffusion strategy, which is designed to encourage adoption of the innovation

8) Lee, J.R., 1989; "Spatial diffusion of agricultural innovation and regional evolution, *Geography*," 39, 39-57.
Park, C.S., 1981, *Diffusion of Rototillers in Rural Korea to 1977*, Ph.D. Dissertation, University of Hawaii Department of Geography.

9) Brown, 1981, *op. cit.*

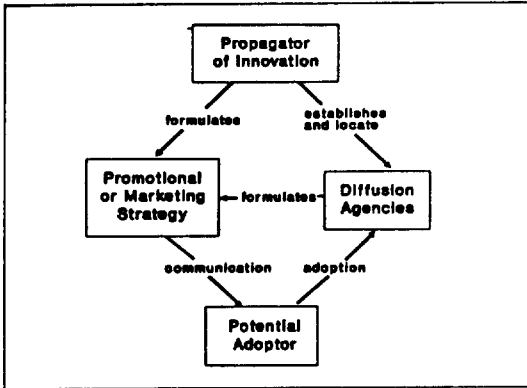


Figure 3. Schematic of the Market and Infrastructure Perspective on Innovation Diffusion

and includes choice of diffusion agency locations where the innovation is made available, pricing, advertising, and population segments to be targeted by promotional efforts.

The relation of these components to one another and to adoption is indicated in Figure 3.

In general, then, the Market and Infrastructure perspective is a conceptual framework that emphasizes the marketing of innovations and the importance of public infrastructure relevant to their spread. To illustrate the latter, broadcast television stations must be operating before television sets can be diffused or marketed; and enhanced accessibility through communication or transportation improvements both increases the market area of diffusion agencies and renders innovations more attainable to potential adopters.

3. Innovation Diffusion: A Prospective View

Geographic research on innovation diffusion has progressively shifted its focus. Earlier studies are concerned with empirical regularities in diffusion patterns, models of the diffusion process, and broad generalizations. In addressing these interest, furthermore, diffusion pheno-

mena are seen as examples to either verify or alter generalizations, and subrogated to that concern. More recent studies emphasize substantive understanding particular to the diffusion being considered, and typically ask questions such as What accounts for what we see?, What are the mechanisms of this diffusion?, What processes underlie these diffusion patterns?. That is, interest has shifted towards articulating a concrete, detailed understanding of specific phenomena and how they spread from place to place. Accordingly, our substantive understanding of these phenomena, in their own right, has increased markedly.

Another research shift pertains to the items being studied. Consumer innovations were the primary focus of work during the 1970s and earlier, whereas technological innovations have received an increasing amount of attention recently. Concomitant with this shift, rather than a single, unchanging, easily identifiable innovation, the object of study tends to be more complex; for example, innovations that are a composite of specific items which may take on different forms in different settings.

To illustrate these general trends, three research areas are highlighted: Consumer Innovations and Application of the Market and Infrastructure Perspective; The Diffusion of Development in Third World Settings; and Technological Innovations and Regional Differences in Their Occurrence.

(1) Consumer Innovations and Application of the Market and Infrastructure Perspective

This focus has received relatively little attention, which is surprising in light of its relevance to Marketing Geography, an increasingly important area of Applied Geography. In fact, one of the better illustrations is provided outside of Geography by a Rural Sociology study of microcomputers in agriculture by Audirac and

10) Audirac, I. and Beaulieu, L.J., 1986, "Microcomputers in agriculture: a proposed model to study their diffusion/adoption," *Rural Sociology*, 51, 60-77.

Beaulieu. Directly employing the Market and Infrastructure framework, this study weighs the relative importance of two supply-side factors: technological improvements and distribution strategies.

As performance level has risen and price level dropped, microcomputers have become accessible to an ever expanding market of potential adopters. Because the market expanded to persons who were less prone towards computer use, distribution strategies became more, rather than less, important. Hence, technological improvements and distribution strategies operated in a complementary, rather than competing, fashion.

In detailing distribution strategies, three sets of diffusion agencies were identified by Audirac and Beaulieu:

- Private agencies or farm consulting firms, which arose to bridge the communications gap between farmers who knew little about computing and computer sales people who knew little about farming.
- Public agencies such as the United States Agricultural Extension Service and Land Grant Universities, often working cooperatively; these developed computer software, identified tasks where computers could be useful, and played an important role in persuading farmers to adopt microcomputer technology.¹¹⁾
- Private, non-profit organizations which typically were user-groups comprised of

farmers who both persuaded and assisted new adopters.

Spatial aspects of this diffusion are given no attention since the study was carried out by sociologists, not geographers. One could ask, however,

- In what ways was there either an explicit or implicit spatial dimension to the marketing strategies employed to diffuse micro-computer use in agriculture?
- How did the actions of each diffusion agency have differing spatial effects?

In Geography, Sugiura employs the Market and Infrastructure perspective to study the spread of Rotary Clubs through the urban system of Japan.¹²⁾ He identifies five relevant factors: information flows concerning Rotary Clubs, the population threshold needed to establish a Rotary Club, the presence and entrepreneurship of key individuals in a given city who might establish a Rotary Club, propagation efforts by the central Rotary organization, and government regulations.

Finally, note should be made of Holttä's recent effort to mathematically model innovation diffusion in a manner that incorporates the Market and Infrastructure perspective.¹³⁾ Also, Kim draws on this perspective to examine the spatial diffusion of Korea's 1919 independence movement; J.R. Lee uses it to examine the spatial diffusion of recent labor unrest among Korean industrial workers related to unionization demands and among Korean farmers related to an irrigation tax increase.¹⁴⁾ Another interesting

-
- 11) The Agricultural Extension Service is a government agency with personnel in all counties throughout the United States; its mission is primarily to assist farmers with technical information, knowledge of contemporary agricultural practices, and the like. Land Grant Universities are state funded institutions, some of which are assigned major responsibility for agricultural development; in such cases, there would be a direct affiliation with the State's Agricultural Extension Service.
 - 12) Sugiura, Y., 1986, "Diffusion of Rotary Clubs in Japan, 1920-1940: a case of non-profit motivated innovation diffusion under a decentralized decision making structure," *Economic Geography*, 62, 125-143.
 - 13) Holttä, R., 1989, *Multidimensional Diffusion of Innovation*, Helsinki School of Economics and Business Administration, Acta Academiae Oeconomicae Helsingiensis, Series A: 66, Helsinki, Finland.
 - 14) Kim, B.S., 1979; The spatial diffusion of the 1919 independence movement (March 1st Movement)," *Geography*, 19, 27-40.

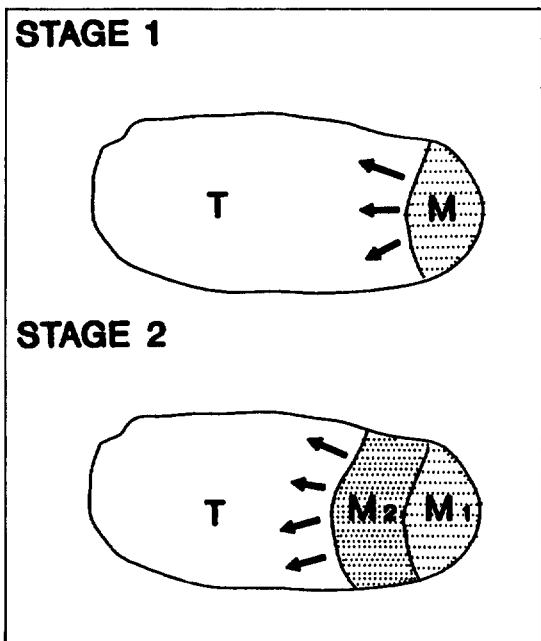


Figure 4. Modern(M) and Traditional(T) Segments of a Third World Landscape and their Change Over Time

study, by H.Y. Lee, focusses on factors underlying the spread of shopping centers in Korea; that is, in Market and Infrastructure terms, the spread of diffusion agencies themselves.¹⁵⁾

(2) The Diffusion of Development in Third World Settings

From a geographical or spatial perspective, development (or modernization) represents a progressive change in the landscape whereby the developed area increases in size and the less-developed area decreases (Figure 4). A

major paradigm, or model, to account for the spread of development has been Modernization Theory, discussed in detail by Rogers.¹⁶⁾ This holds

- That modernization is a diffusion process;
- That communication from modern (core) to traditional (periphery) regions, or from modern to traditional individuals, is the major mechanisms by which attitudes are altered and modernization occurs.

Hence, modernization theory and Hagerstrand's conceptual framework are identical in their emphasis of communications as the major element of diffusion; conversely, Hagerstrand can be seen as a development model. These models also agree

- That eventually, the whole of an area will adopt the item being diffused, be it a discrete innovation or development/modernization, an amalgam of many innovations;
- That development spreads in a neighborhood effect fashion to contiguous locations (Figure 4).

More generally, the spread of development usually occurs in a core-periphery pattern, where Core is the more developed region and Periphery is the less-developed region (Figure 5). This is true under modernization theory, but also under other long-standing conceptualizations of development such as the two-sector growth model of Economics, core-periphery and growth pole formulations of Geography, dependency theory, or Rostow's stages of economic development.¹⁷⁾

Lee, J.R., 1989, Spatial diffusion of labor complaints in Korea, 1987, *Academic Journal of Chonnam University*, 34, 79-107.

Lee, J.R., 1990, Spatial diffusion and regional structure of the farmers discontent in Korea, 1987-1989: a case study of the Rejection Movement for Irrigation Tax," *Geography*, 41, 57-78.

15) Lee, H.Y., 1984, "Diffusion of an innovation through an urban system: the spread of shopping centers in Korea, *Journal of Geography*, 11, 21-37.

16) Rogers, E.M., 1969, *Modernization Among Peasants: The Impact of Communications*, Holt, Rinehart, and Winston, New York.

17) For a review of development conceptualizations, and further references, see Chapter 2 of Brown, L.A., 1990, *Place, Migration, and Development in the Third World: An Alternative View*, Routledge, London and New York.

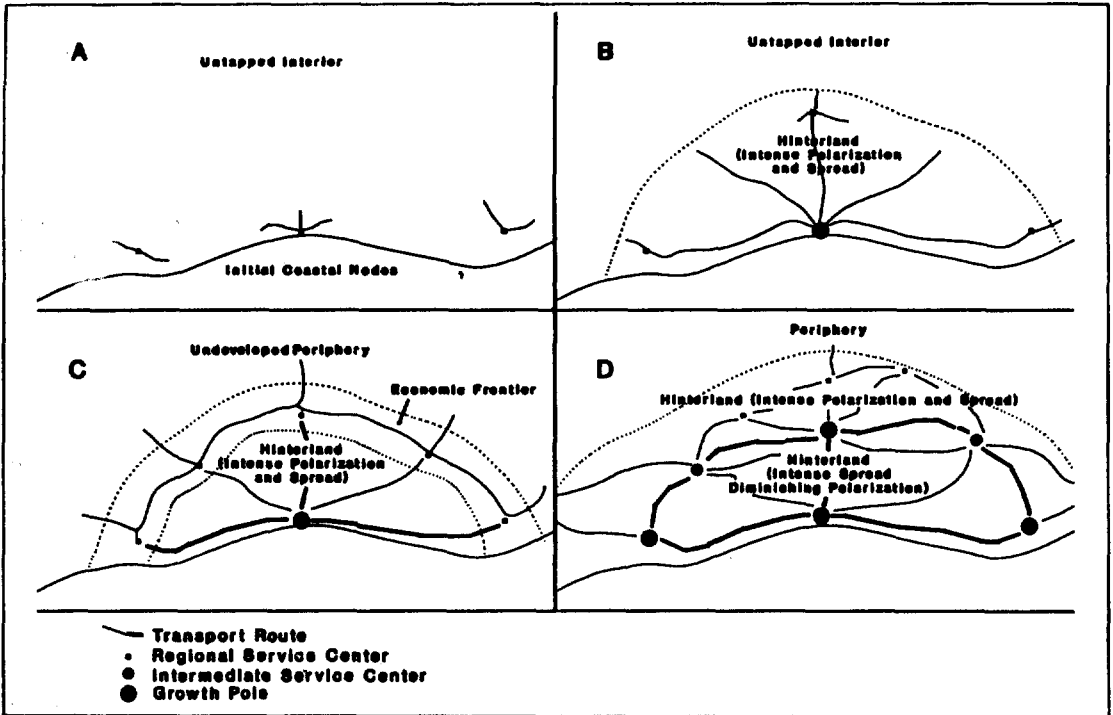


Figure 5. The Spatial Spread of Development as a Core-Periphery Phenomenon

However, *Place, Migration, and Development*, Brown's most recent book, argues that the standard conceptualizations do not provide an adequate explanation of development/modernization.¹⁸⁾ Instead, this book

- Points out that Third World landscapes exhibit change that is sometimes positive, sometimes negative, and sometimes neutral;
- Notes that development implies continual progress and positive change;
- Emphasizes, therefore, that regional change rather than development is the appropriate focus;
- Sees regional change as a function of the interaction between exogenous forces and local (endogenous) conditions so that a given exogenous force may lead to different local outcomes;

- Posits that exogenous forces fall into three major categories: world economic and political conditions, donor nation actions, and policies of Third World nations.

Figure 6 presents a schematic outline of this framework. Its vast departure from the standard approach to development can be seen by a comparison with Figure 2, which depicts the Hagerstrand and, implicitly, Modernization Theory approaches. Hence, our understanding of development, a diffusion phenomenon, has become deeper, more complete, and refined. Yet, Brown's framework is only a sketchy start, and filling in its outline will require considerable research in the future.

(3) Technological Innovations and Regional Differences in Their Occurrence

18) Brown, 1990, *op. cit.*

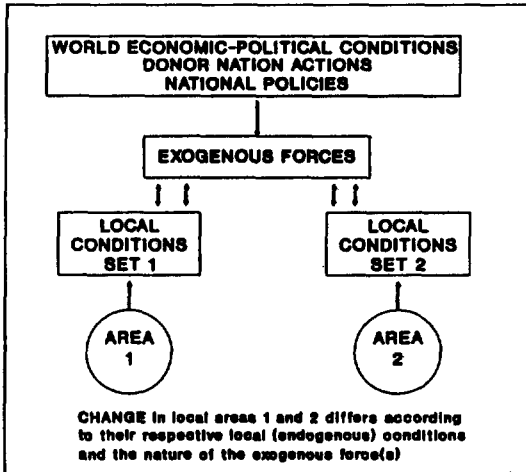


Figure 6. Schematic of the Landscape Change Process in Third World Setting, as Proposed by Brown(1990)

At the time of Brown's innovation diffusion book, research on both technological and consumer innovations tended to focus on discrete innovations and how they were adopted (demand-side) rather than how they were made available (supply-side). However, while studies of consumer innovations focussed on communication/information flows, the diffusion of technological change was seen in terms of innovation and firm characteristics. Hence, regional differences in the adoption, or occurrence, of technological innovations were traced to the size of firms likely to be early adopters and where, or in what size cities, such firms are located. This led to the generalization that technological change was expected earlier in regions with either medium-size or large-size cities, depending on characteristics of the innovation itself; and in all cases, that regions with small urban agglomerations were expected to lag in adoption.¹⁹⁾

Today, the study of technological innovation embodies a view of the diffusion process that is considerably more complex. To illustrate,

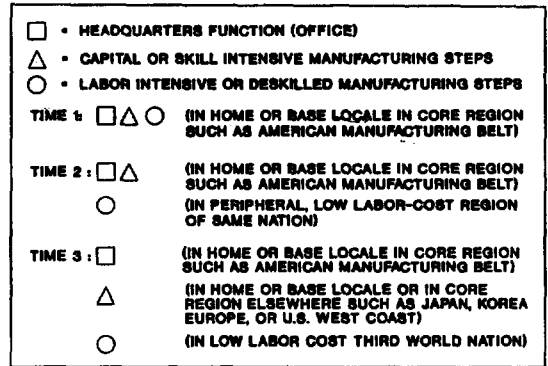


Figure 7. Dismemberment of the Production Process Over Time

consider the spatial and temporal dynamics manifest in the internationalization of production systems and production organization.

Since the mid-1960s there has been a revolution in information transfer and transportation technologies whereby the costs of interaction have become dramatically reduced. As a result

- The production process can be more readily dismembered so that manufacturing steps occur in different, often distant locations to take advantage of factor cost variations. Figure 7 provides a schematic illustration. Another illustration is the global office whereby a New York resident may mail an insurance claim to a New York office and receive payment within a week, but processing the claim takes place in Ireland where labor costs are considerably less (New York Times, October 18, 1988).
- In a similar fashion, manufacturing at different stages of the production life cycle can take place at increasingly distant, often foreign locations; Figure 8 provides a schematic illustration.
- International competition is heightened since no market is protected by transport-cost shields. The imperative to minimize

19) See Brown, 1981, *op. cit.*, especially Chapter 5. Malecki, E.J., 1983, "Technology and regional development: a survey, *International Regional Science Review*, 8, 89-125.

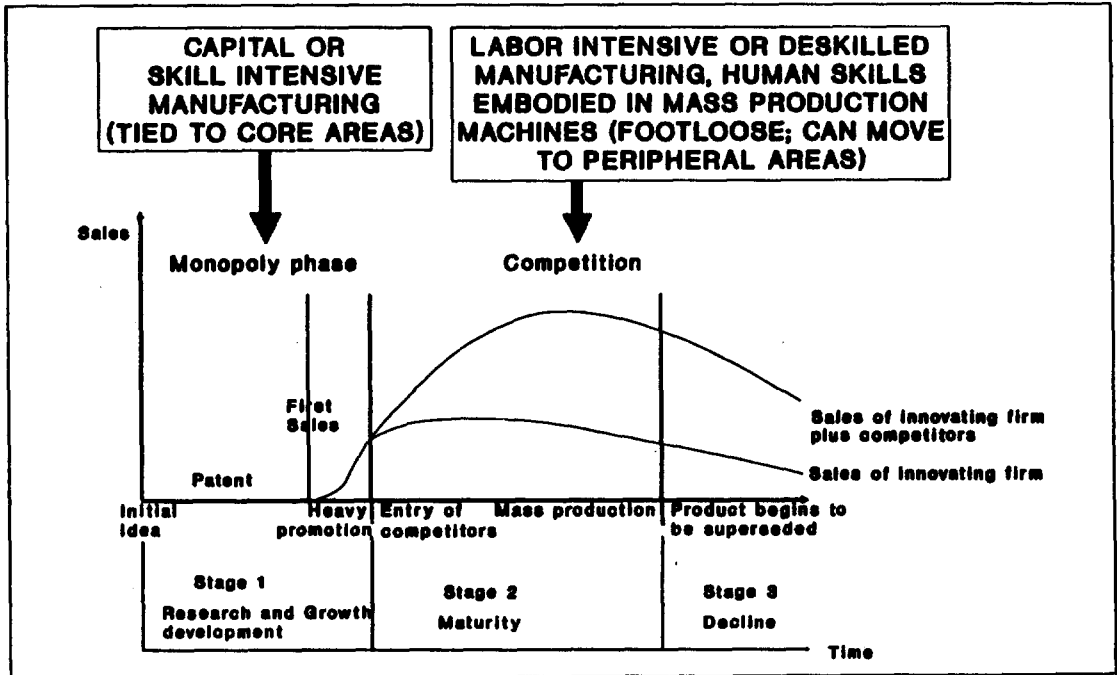


Figure 8. A typical Product Life Cycle and Implication for the Location of Production

costs grows accordingly, and therefore, spatial strategies of production have become increasingly critical. Results include a pronounced international division of labor and internationalization of ownership in all types of economic activity; also, the growing importance in the world order of multinational corporations and foreign direct investments.

Dynamics such as these underlie enormous shifts in the location and character of economic production, especially in manufacturing; and overall, these shifts constitute a diffusion process. Although this connection is sometimes

acknowledged, as in the work of S.O. Park, researchers have not attempted to enhance either diffusion theory, or our understanding of industrial landscapes, by linking the two.²⁰⁾

In this spirit, however, S.O. Park, drawing on Malecki, provides an important observation concerning the spatial differentiation of production systems and regional dynamics.²¹⁾ He points out that diversification among economic sectors is usually seen as a critical element of regional strength, but just as important, yet seldom considered, is the stage in the Production Life Cycle represented by firms in a region. To the extent firms represent the Standardized Production phase (Maturity, Figure 8), and branch

- 20) Park, S.O., 1985; "High technology industries, R & D activities, and regional development in Korea," *The Korean Journal of Regional Science*, 1, 37-50.
 Park, S.O., 1986; "Regional changes in the industrial system of a newly industrializing country: the case of Korea;" in Hamilton, F.E.I., ed., *Industrialization in Developing and Peripheral Regions*, Croom Helm, London, 311-334.
 Park, S.O., 1987; "Recent development and linkages of high technology industries in the Seoul metropolitan area," *The Korean Journal of Regional Science*, 3, 21-35.
- 21) Park, S.O., 1985, *op. cit.*
 Park, S.O., 1986; "Spatial dynamics of industrial structure in Korea", *Geography*, 34, 67-81.

rather than headquarter plants, a region will be weaker in its economic resilience, regardless of sectoral diversification. Hence, since a single stage of the Production Life Cycle often dominates regional economic structures, there is a need for policy measures that enhance a balanced diffusion of production system characteristics and reduce regional disparities.²²⁾ Related issues, in a Korean context, are addressed by H.Y. Lee, J.R. Lee, and C.S. Park.²³⁾

Another aspect of regional differences in production system characteristics concerns the impact of particular innovations on the manufacturing process and productivity. Consider the adoption, in the United States and Japan, of flexible manufacturing systems as discussed by Jaikumar.²⁴⁾ A study of firms with similar systems (6-7 individual machines) showed that United States firms

- Took approximately one year longer to develop systems into a full-fledged production element;
- Made less use of the system's 'flexibility' advantage over conventional production processes by, for example, producing many fewer parts;
- Used more labor per flexible manufacturing system, and used the system less hours.

Hence, United States firms adopted the flexible manufacturing system innovation, but did not fully reap its advantages with regard to improv-

ing productivity.

A similar study could be addressed to international differences in the impact of flexible manufacturing or other technological innovations. That is,

- How does impact vary among regions within, say, Korea.

Alternatively,

- How do production systems themselves vary among regions. For example, what are the differences among Korean regions in the occurrence or use of Just-In-Time inventory, Just-In-Case inventory, Fordist/assembly line manufacturing, and flexible specialization manufacturing.²⁵⁾

And,

- How can we account for the differences that are observed?

4. Summary Statement

This paper reviews trends in innovation diffusion research, both retrospectively and prospectively. The topic has been a major theme of geographic inquiry. Accordingly, questions addressed by diffusion research, the conceptual framing of those questions, methodologies employed, and changes in each of these aspects have reflected the orientation of Geography overall.

In the earlier decades of this century, therefore, innovation diffusion was studied as a

22) For a detailed discussion of appropriate policy measures, see Park, S.O., 1985, *op. cit.*

23) Lee, H.Y., 1987, "Economic development and migration: policy perspectives, *Academic Journal of Kon-Kuk University*, 31, 327-353.

Lee, H.Y., 1987, "The process of spatial dispersion and its determinants in Korea," *Korean Journal of Regional Science*, 3, 53-72.

Lee, H.Y., 1989, "Growth determinants in the core-periphery of Korea," *International Regional Science Review*, 12, 147-163.

Lee, J.R., 1987, "Research trends and problems on the spatial diffusion of innovation," *Academic Journal of Chonnam University*, 32, 117-146.

Park, C.S., 1981, *op. cit.*

24) Jaikumar, R., 1986, "Postindustrial manufacturing," *Harvard Business Review*, 64, 69-76.

25) For a discussion of these and related aspects of production system organization see Dicken, P. and Lloyd, P.E., 1990, *Location in Space: Theoretical Perspectives in Economic Geography*, Harper and Row, New York and London, especially pages 332-338 and 383-397.

broadly relevant process related to cultural change. Later, as a reflection of Geography's quantitative revolution, study took a more narrow focus in that particular innovations were considered only in so far as they served to amplify mathematical or statistical models. Presently, broad themes are once more emerging, but based on extensive substantive knowledge of particular innovations.

Said another way, substantive phenomena now tend to be viewed in their own right rather than as examples through which theoretical diffusion issues are explored. Today, researchers ask What accounts for what we see?, What are the mechanisms of this diffusion?, What processes underlie these diffusion patterns?. Interest has shifted towards articulating a concrete, detailed understanding of specific phenomena and how they spread from place to place. However, this has led to the quandary that development/modernization, internationalization of production processes, spatial divisions of labor, technological innovation, regional change, and the like are rarely identified as diffusion phenomena per se.

Given the tendency in earlier years to over-emphasize general, isomorphic properties of substantively different phenomena, the current emphasis is both understandable and healthy.²⁶⁾ It is understandable as a reaction to the cul de sac in knowledge acquisition that came to typify modeling efforts; it is healthy in that the innovations we examine are more complex and our

knowledge more complete.

Nevertheless, science moves in cycles, and at the present time, giving increased attention to diffusion aspects is likely to reap important gains in our understanding. Consider, for example, the internationalization of production processes. Heretofore, researchers have primarily examined the evolution of conditions giving rise to internationalization; e.g., dismemberment of the production process (represented by movement from phase 1 to phase 3 in Figure 7) which may be traced to political economy conditions, factor cost advantages, and changes in communication-transportation technologies. Equally important, however, is why some industries and some firms within industries have engaged in internationalization, while others have not or have done so to a lesser extent.²⁷⁾ Such differences constitute a diffusion question which would expand our knowledge of both diffusion processes and the internationalization of production.

More generally, at the present time there may be gains in re-recognizing the communality among substantively differing phenomena which, at one level, share a diffusion identity. This would establish a link between specialties such as development, transportation, population, and industrial geography. More importantly, by exposing and exploring the link between substantively different phenomena, transference of knowledge that would enhance the study of each might be facilitated.

26) For a discussion of isomorphism in diffusion studies, see Brown, L.A., 1968, *Diffusion Processes and Location*, Regional Science Research Institute, Philadelphia, pages 6-8.

27) Further discussion on this point is found in Castells, M., 1989, *The Informational City: Information Technology, Economic Restructuring, and the Urban-Regional Process*, Basil Blackwell, Oxford, especially pages 75 and 113-117.