CHAPTER 2

UP-DATE: THE GLOBAL DIFFUSION ANALYTIC FRAMEWORK

This chapter briefly reviews the framework for analyzing the development and status of the Internet within a country that was established in the first Global Diffusion report,[3] from which the following discussion is drawn. The principal components of the framework are six "dimensions" and an open-ended list of "determinants."

Dimensions represent a number of interrelated factors that comprise the "Internet capability" of a nation. Each of the six dimensions (Table 1) is given a numeric score supported by a narrative discussion. Displayed graphically on Kiveat diagrams, a dimensional analysis represents a time-slice view that facilitates both assessment of the Internet within a country and comparisons between countries and regions. Compilation and analysis of the determinants and relevant government policies not only establishes how the current situation came to be, but can inform decision-makers of the likely consequences of future regulatory or investment decisions on the further development of Internet capabilities.

Table 1. Dimensions of Internet Diffusion	
Dimension	Function
Pervasiveness	Number of users per capita
Geographic Dispersion	Physical dispersion of infrastructure and access
Sectoral Acceptance	Connectivity in various social sectors
Connectivity Infrastructure	Capacity and robustness of the infrastructure
Organizational Infrastructure	Degree of competition
Sophistication of Use	Integration and innovation

Of the six dimensions, three answer the question: "How much?" The final three dimensions reflect structural variables: Connectivity Infrastructure represents the degree to which users can effectively communicate via the Internet and the number and speed of a country's international connections. Organizational Infrastructure describes the richness and robustness of the Internet service provision market, and hence the potential for further proliferation. It also is the dimension that best reflects one of the most important variables in Internet diffusion, government policy. The final dimension, Sophistication of Use, represents the degree to which the technology has really caught hold within a country and become an integral part of that country's social, economic, and management fabric.

Pervasiveness is a function principally of the number of subscribers and hosts per capita. This is a change from the original definition of this dimension, which originally also attempted to reflect the growth of Internet use beyond a core group of technical experimenters and "early adopters" to the

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[3] Chapter 2 in Goodman, et al., *The Global Diffusion of the Internet Project: An Initial Inductive Study, op. cit.*, pp. 4-28.

general public, and ease with which the population can get Internet service.[4] The original definition did not account for situations where there were relatively low levels of use but the user community comprised more than a technical core. Additionally, the ease of access issue is also accounted for in other dimensions, and so was dropped from *pervasiveness* for clarity. The subjective descriptor for Level 1 was also changed, to "embryonic" from "experimental," as we have discovered several examples of countries that were clearly at Level 1 for *pervasiveness* but where Internet use was well beyond the experimental stage. The elements of *pervasiveness* as currently defined are listed in Table 2. The term "users" must also be qualified, since it allowed for a great degree of ambiguity in applying the original definition. The intent is to as accurately as possible the number of people who are regular users of the Internet. Such numbers are not readily available. However, it is often possible to obtain or reasonably estimate the number of subscribers, that is, Internet account holders. The actual number of users is usually larger by factors that varying greatly from country to country, from Internet service provider (ISP) to ISP, and even within a country. There is no way to measure this number and such published estimates as exist are of questionable validity.

Table 2. Dimensions of Internet Diffusion: Pervasiveness
Level 0 *Non-existent:* The Internet does not exist in a viable form in this country. No computers with international IP connections are located within the country. There may be some Internet users in the country; however, they obtain a connection via an international telephone call to a foreign ISP.
Level 1 *Embryonic:* The ratio of users per capita is on the order of magnitude of less than one in a thousand. The ratio of hosts per capita is less than 12 hosts per 10 million people.[5]
Level 2 *Established:* The ratio of Internet users per capita is on the order of magnitude of at least one in a thousand. There are fewer than 1,700 hosts per 10 million people.
Level 3 *Common:* The ratio of Internet users per capita is on the order of magnitude of at least one in a hundred. The ratio of hosts per capita is between 1,700 and 70,000 hosts per 10 million people.
Level 4 *Pervasive:* The Internet is pervasive. The ratio of Internet users per capita is on the order of magnitude of at least one in ten. There are more than 70,000 hosts per 10 million people (7 hosts per 1,000 people).

Geographic Dispersion describes the physical dispersion of the Internet within a country, there being benefits to having multiple points-of-presence, redundant transmission paths, and multiple international access points. Internet development in a country typically starts with a single provider and site in the capital or largest population center, from which the infrastructure spreads out as the user population grows and becomes more diversified. A mature Internet network will feature an infrastructure distribution that is proportional to the population. Table 3 summarizes the

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[4] *ibid.*, p. 5.

[5] The host/capita quartiles are derived from the host distribution map presented by Larry Press inside the back cover of *OnTheInternet* 3 (January/February 1997).

characteristics used to evaluate geographic dispersion. The original definitions of *geographic dispersion* levels included an assessment of the number of international IP links. This was duplicative and therefore dropped from this dimension.

Table 3. Dimensions of Internet Diffusion: Geographic Dispersion
Level 0 *Non-existent:* The Internet does not exist in a viable form in this country. No computers with international IP connections are located within the country.
Level 1 *Single Location:* Internet points-of-presence are confined to one major population center.
Level 2 *Moderately Dispersed:* Internet points-of-presence are located in at least half of the first-tier political sub-divisions of the country.
Level 3 *Highly Dispersed:* Internet points-of-presence are located in at least three-quarters of the first-tier political sub-divisions of the country.
Level 4 *Nationwide:* Internet points-of-presence are located in all first-tier political sub-divisions of the country. Rural access is publicly and commonly available.

Sectoral Absorption recognizes the differing impacts of the degrees to which four major Internet-using sectors of society have taken up the technology: the academic, commercial, health, and public (government) sectors. While the sectors describe the major social and economic divisions in society, none are homogeneous, as depicted in Table 4. Personal use is not considered in this metric.

Internet use within each sector is rated as rare, moderate, or common, according to the guidelines listed in Table 5. To rate the country as a whole, each sector with a "rare" rating is assigned one point, each "moderate" sector two points, and each "common" rating three points. The overall rating for Sector Absorption is derived from the matrix shown in Table 6.

Table 4. Subsectors of the Social Structure	
Sector	Subsectors
Academic	Primary and Secondary education University education
Commercial	Distribution Retail Finance Service Manufacturing
Health	Hospitals Research Centers Clinics Physicians/Practitioners
Public	Central government Regional and Local governments Public companies Military

Table 5. Assessing Sectoral Absorption			
Sector	Rare	Moderate	Common
Academic-primary and sec-ondary schools, universities	< 10% have leased-line Internet connectivity	10-90% have leased-line Internet connectivity	> 90% have leased-line Internet connectivity
Commercial-businesses with more than 100 employees	< 10% have Internet servers	10-90% have Internet servers	> 90% have Internet servers
Health-hospitals and clinics	< 10% have leased-line Internet connectivity	10-90% have leased-line Internet connectivity	> 90% have leased-line Internet connectivity
Public-top and second tier government entities	< 10% have Internet servers	10-90% have Internet servers	> 90% have Internet servers

Table 6. Sectoral Absorption Rating		
Sectoral point total	Absorption dimension rating	
0	Level 0	Nonexistent
1-4	Level 1	Rare
5-7	Level 2	Moderate
8-9	Level 3	Common
10-12	Level 4	Widely used

Connectivity Infrastructure comprises four components: the aggregate bandwidth of the domestic backbone(s), the aggregate bandwidth of the international IP links, the number and type of inter-connection exchanges, and the type and sophistication of local access methods being used. Table 7 depicts how these factors are related to the assessment of the infrastructure's level of develop-ment, with Level 0 assigned to a country with no Internet presence (and hence, no infrastructure) and Level 4 assigned to a country with a robust domestic infrastructure, multiple high-speed international links, many bilateral ("peering") and open Internet exchanges—facilities where two or more IP networks exchange traffic, and a variety of access methods in use.

Table 7. Dimensions of Internet Diffusion: Connectivity Infrastructure				
	Domestic Backbone	International Links	Internet Exchanges	Access Methods
Level 0	None	None	None	None
Level 1	< E-1	≤ 128 Mbps	None	Modem
Level 2	T-3 — OC-4	T-1 — T-3	1	Modem 64 Kbps leased lines
Level 3	OC-4 — 100 Gbps	T-3 — 10 Gbps	More than 1; Bilateral or Open	Modem > 64 Kbps leased lines
Level 4	≥ 100 Gbps	≥ 10 Gbps	Many; Both Bilateral and Open	< 90% modem > 64 Kbps leased lines

Organizational Infrastructure Just as the connectivity infrastructure assessed the extent and robustness of the physical structure of the network, organizational infrastructure (Table 8), derived from the number of ISPs and the competitive environment, assesses the robustness of the market and services themselves. Generally, an open, competitive market with low barriers to market entry is more conducive to high rates of take-up by subscribers, wider proliferation of the physical infrastructure, and the provision of a wider variety of services.

Table 8. Dimensions of Internet Diffusion: Organizational Infrastructure
Level 0 *None:* The Internet is not present in this country.
Level 1 *Single:* A single ISP has a monopoly in the Internet service provision market. This ISP is generally owned or significantly controlled by the government.
Level 2 *Controlled:* There are only a few ISPs because the market is closely controlled through the maintenance of high barriers to entry. All ISPs connect to the international Internet through a monopoly telecommunications service provider. The provision of domestic infrastructure is also a monopoly.
Level 3 *Competitive:* The Internet market is competitive and there are many ISPs due to the existence of low barriers to market entry. The provision of international links is a monopoly, but the provision of domestic infrastructure is open to competition.
Level 4 *Robust:* There is a rich service provision infrastructure. There are many ISPs and low barriers to market entry. The provision of international links and domestic infrastructure are open to competition. There are collaborative organizations and arrangements such as public exchanges, industry associations, and emergency response teams.

Sophistication of Use To truly understand the Internet capability of a country, it is necessary to understand not only how many and where people use the services, but how the Internet is employed. Of particular interest is the "elbow" reached when the service is mature enough to attract interest and use outside the narrow community of technicians. A second major milestone is reached when the user community transitions from only using the Internet to creating new applications, sometimes eventually having an impact on Internet use elsewhere. Table 9 depicts the development stages that reflect an increasing sophistication in the use of the Internet.

Determinants influence the Internet capability of a country and shape its development over time. The current dimensions of a country's Internet capabilities resulted from the interactions of these determinants, which were in turn affected by the diffusion of the Internet. A country's future Internet capabilities will continue to be the result of the actions and interactions of these dimensions, most of which are not themselves static. The determinants are discussed in greater detail in the first Global Diffusion report.[6]

The most important determinant, government policy, belongs in a category by itself, since the policies of government overlay all other determinants, affecting both their nature and their effectiveness, based upon a government's ability to exercise coercive power. The policies created by a

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[6] Goodman, et al., *The Global Diffusion of the Internet Project: An Initial Inductive Study, op. cit.*, pp. 11-16.

government are generally intended to achieve the fulfillment of that government's goals, which may be more or less closely related to the goals of those governed, depending upon the form of government. The government's policies may also appear to be more or less rational, depending upon how well the policy reflects the realities of its milieu, but governments can—and all too often do—create policies that reflect a lack of awareness or understanding of its environment, or an excessive optimism regarding the government's ability to overcome obstacles to its policies.

Table 9. Dimensions of Internet Diffusion: Sophistication of Use
Level 0 *None:* The Internet is not used, except by a very small fraction of the population that logs into foreign services.
Level 1 *Minimal:* The small user community struggles to employ the Internet in conventional, mainstream applications.
Level 2 *Conventional:* The user community changes established practices somewhat in response to or in order to accommodate the technology, but few established processes are changed dramatically. The Internet is used as a substitute or straight-forward enhancement for an existing process (e.g., e-mail vs. post). This is the first level at which we can say that the Internet has "taken hold" in a country.
Level 3 *Transforming:* The user community's use of the Internet results in new applications, or significant changes in existing processes and practices, although these innovations may not necessarily stretch the boundaries of the technology's capabilities.
Level 4 *Innovating:* The user community is discriminating and highly demanding. The user community is regularly applying, or seeking to apply the Internet in innovative ways that push the capabilities of the technology. The user community plays a significant role in driving the state-of-the-art and has a mutually beneficial and synergistic relationship with developers.

Porter postulated four basic determinants of national advantage, which serve here to describe the general nature of the determinants of Internet diffusion.[7] *Factor conditions* refer to the factors of production, the inputs for any industry or enterprise. While most factor conditions are subject to change caused by outside influences, such change, when it occurs, is generally slow and incremental. The *Constituents*, which Porter called "demand conditions" describe the nature of the market with respect to the demands of sophisticated users, the breadth and variety of demands, and the size and patterns of demand growth. Porter notes that the quality of demand is more important than the quantity of demand. The Internet, like other technologies and innovations, usually does not simply appear in a particular country; it is introduced into the country to satisfy the demands of one or more constituent groups, such as the business or academic communities. The strength of these constituencies and their demands relative to conditions either supporting the *status quo* or specifically opposed to the Internet determine whether efforts to develop the

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[7] Michael E Porter, *The Competitive Advantages of Nations* (New York: The Free Press, 1990), pp. 71-72. Porter's "firm strategy, structure, and rivalry" was shortened to "strategy, structure, and rivalry" for clarity in the context of Internet development.

Internet in a particular country will be successful, and are major factors in the speed with which Internet service proliferates. *Related and supporting industries* refers to the quality of industries required for the introduction and development of, in this case, the Internet, and the relationships between industries. The presence and condition of supporting industries is generally not as critical to Internet diffusion as it is to industrial activities. Related industries such as software development concerns can, however, act as a spur to Internet diffusion. Most important is the degree of development of the telecommunications infrastructure, the nature of the sector (monopoly or open), and the relationship between telecommunications operators and ISPs. *Strategy, structure, and rivalry* refers to the ease of formation of new companies, barriers to market entry, and the competitive environment.