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## Telecommunications

### Book section

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Failures in technology transfer are frequently the result of a lack of coordination or misplaced assumptions. In 1979, for example, the **United Nations Children's Fund (UNICEF)** located two new biomass electricity generators in Fateh-Singh-Ka-Purwa village in India. The project failed because it overestimated the supply of dung as fuel because it used national, rather than locally gathered figures. Because of this overestimation, the price of dung increased, making the biomass generators uneconomic. Similarly, in the Philippines in the 1980s, the government installed charcoal gasifiers for electricity generation as a way to enhance the pumping of irrigation water. Farmers had agreed to accept the technology because it was offered free of charge. But in practice, farmers still preferred to use rainwater because this was seen to be more reliable. The project failed because of insufficient attention to market demand and local practices. Indeed, the example indicated the need for technology to be appropriate to the needs of local users, rather than simply technically efficient in producing a desired result.

Successful technology transfer at the local scale therefore depends on the correct alignment of local technological needs; sustainable financial management; and the creation of **technological capability** – or the existence of local institutional capacity for educating people about technology, recovering costs, and incorporating (even developing) technology into industrialization. Long-term horizontal technology transfer, therefore, is a painstaking approach that may involve **partnerships** between citizens, governments and investors.

**See also:** appropriate technology; capacity building; climate change; foreign direct investment; joint venture; technological capability; technology policy; transnational corporations (TNCs)

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TIM FORSYTH

## telecommunications

Telecommunications networks and services can provide an important component of the infrastructure for **economic development** and **social development**. Starting with telegraphy and voice telephone services, historically, telecommunications infrastructure and services were provided mainly by monopoly state-owned Post, Telegraph and Telephone (PTTs) administrations. With the advent of digital technologies and large increases in data communication as compared to voice traffic, the telecommunications industry has been transformed into a more competitive sector and is offering an increasingly wide variety of services. Digital technologies are transforming the telecommunications network into an infrastructure capable of carrying voice, data, graphics, video and audio signals.

**Privatization and liberalization**, and technological change are creating significant issues for developing countries that seek to extend telecommunications services to the majority of their citizens and business users. Shifts in policy and regulation in the industrialized countries from the 1970s onwards resulted in competitive entry in national and international telecommunications markets. Pressures to liberalize markets and to privatize telecommunications operators have come from the wealthy industrialized countries and the WTO (see **World Trade Organization/General Agreement on Tariffs and Trade (WTO/GATT)**). Developing countries increasingly are

being encouraged to open their markets to foreign investors.

The extension of telecommunications networks beyond the wealthiest segments of developing country populations presents a major challenge. Potential users in rural areas of developing countries often have limited or no access to basic telephone services. However, the declining costs of telecommunications equipment and the spread of satellite and terrestrial wireless communication networks are providing a technological basis for expanding telecommunications services in developing countries. Unfortunately, despite increased investment in telecommunications in the decade of the 1990s in developing countries, for most countries a catch-up to the levels of penetration of telecommunications services is still many years away.

The constraints to the achievement of greater access in these countries are reinforced by inappropriate views of developing country market dynamics. Policy-makers and investors often assume that there is little demand for services in rural areas, despite the fact that many factors other than income levels can influence demand, including the requirements of the **public sector**. Potential telecommunications users have varied requirements for services in addition to voice telephone connections. The telecommunications infrastructure supports access to the Internet and to online services for business and government. In urban areas, investment in the telecommunications infrastructure is being used to attract investors in software development and “back office” service provision, creating new jobs for skilled personnel in some developing countries. Countries such as India have developed an international software industry that relies heavily on the telecommunications infrastructure, but investment has largely failed to bring gains for the poorer urban populations. Many developing countries are putting Universal Service Obligations in place and subsidies or development funds may be available to extend the reach of telecommunications networks. However, these initiatives may protect dominant telecommunications operators from competitive entry and result in a slow down in total investment in the telecommunications infrastructure.

Telecommunications service access is often measured by the percentage of individuals or

households with access to the network, but access models are being developed to enable collective access by schools, hospital clinics, libraries and **community** centers. Evaluations of various tele-center initiatives suggest that there is a need to involve all stakeholders in decisions with respect to the services to be provided, who has access to them, and how basic maintenance and upgrading of equipment is to be funded. In many cases, policy coordination and the removal of bureaucratic barriers to action and investment are larger barriers to success than is the cost of technology.

The extension of affordable access to the telecommunications infrastructure requires the separation of supply from government departments and the creation of a regulatory institution to ensure that all potential investors and services customers are treated equitably. Competitive entry to the telecommunications supply market in some developing countries has boosted the number of mobile telecommunications subscribers and encouraged the spread of Internet access. Where users face unaffordable prices for telecommunications service, they find ways of bypassing dominant operators by using callback or voice services over the Internet. Unfortunately, these initiatives can only marginally reduce the extent of exclusion from affordable access to networks.

In 2000, the **United Nations Report of the High-level Panel on Information and Communication Technology** recommended that the connectivity problem should be addressed as a matter of urgency: “the overall target should be to bring connectivity to all communities by the end of 2004.” The telecommunications access issue, as a subset of access to advanced information and communication technologies of all kinds, is very high on the international agenda. This is because when telecommunications access is established, the use of networks offers opportunities for local, regional and global collaboration in support of development goals. However, learning and capability building are necessary complements to investment in the telecommunications infrastructure. The focus of the debate on the “digital divide” is often on the failure of the private sector to invest sufficiently in a ubiquitous infrastructure, but such investment cannot be regarded as an end in itself. Investment is also needed in

strengthening local capabilities and the knowledge base through training and **education**. This complementary investment is essential if the advantages of access to telecommunications networks are to become available to the majority of the citizens of developing countries.

The capabilities of the telecommunications infrastructure can support Internet access. An increasingly wide range of voice and data services relies on modem communication, Internetworking of local area networks, and broadband connections. The diversity of network access options is being encouraged by new generations of modems with very high digital processing capability. Developments in wireless technology, including cellular radio and rural radio systems as well as new generations of satellite technology, offer the potential for more affordable access to telecommunications services. Developments in computing and software systems are enabling the provision of new services that generate traffic for the telecommunications network, making the business case for supplying network access more attractive to investors in developing countries.

Visions of the potential of the development of electronic commerce for firms in developing countries are premised on the expectation that these countries will achieve equitable access to the telecommunications infrastructure. Similarly, electronic government initiatives using Internet platforms require an underlying telecommunications infrastructure for their success. Digital service applications can support more extensive and effective delivery of health care services and environment protection schemes. For instance, the telecommunications infrastructure can support the use of software applications such as geographical information systems to facilitate improved access to environmental information for citizens, public authorities, and businesses.

**See also:** information technology; Internet; measuring development; new public management (NPM); technology policy; World Summit on the Information Society (WSIS)

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## terms of trade

“Terms of trade” most commonly refers to the ratio of an index of export prices to an index of import prices ( $P_x/P_m$ ). This ratio is more properly known as the *net barter* terms of trade. The terms of trade are crucial for understanding economic factors behind the impact of international trade on many developing countries. Many studies in development economics have shown that (net barter) terms of trade (i.e. the ratio in prices between exported primary commodities and imported manufactured goods) will decline in the long run, meaning comparative loss of profitability for countries exporting primary goods.

In early analyses, classical economists predicted that long-run prices of agricultural products and minerals would rise in relation to those of manufactures, because limited supplies of agricultural land and mineral deposits would cause diminishing returns to increasing the labor and capital employed in those activities. In contrast, however, work after the World War II independently by Raúl Prebisch and by Hans Singer showed that terms of trade for developing countries – at the time almost entirely dependent on primary products for their export earnings – had been declining since the nineteenth century (see **trade**). The