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Implications of Intellectual Property Rights for the Access to and Use of Information Technologies in Developing Countries

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Editor's Note

With pleasure we present to our readers the special series of UNU/INTECH Discussion Papers: **Information Revolution and Policy Implications for Developing Countries.** Papers of the Series were originally developed for the International Workshop on The Information Revolution and Economic and Social Exclusion in Developing Countries, held in Maastricht on 23 -25 October 1996. The Workshop was an important event organized by UNU/INTECH and financed by the Dutch Government. Insights developed from the Workshop have not only been benefiting UNU/INTECH research work, but also contributing to many other initiatives in the area of innovation policy for information technology in developing countries.

There are six papers in the special series. The first five papers have been widely circulated and are provided here in the latest modified versions. These are outcomes from the two major themes set for the Workshop: 'The Developments of Access and Effective Use of Information Technology and Exclusion', and 'The Gender Dimension in Exclusion'. The sixth paper, by Ludovico Alcorta, is a summary of the three country cases on Burkina Faso, South Africa and Tanzania organized for the Workshop.

#2002-1* Charles Cooper, "Some Themes for the Workshop: An Outline for Policy Analysis"

#2002-2* Constantine Vaitsos, "Policy Agenda for the Information Revolution and Exclusion Phenomena in Developing Countries"

#2002-3* Shulin Gu and W. Edward Steinmueller, "National Innovation Systems and the Innovative Recombination of Technological Capability in Economic Transition in China: Getting Access to the Information Revolution"

#2002-4* Carlos M. Correa, "Implications of Intellectual Property Rights for the Access to and Use of Information Technologies in Developing Countries

#2002-5* Cecilia Ng Choon Sim, "Making Women's Voices Heard: Technological Change and Women's Employment with Special Reference to Malaysia"

#2002-6* Ludovico Alcorta, "The Information Revolution and Economic and Social Exclusion: The Experiences of Burkina Faso, South Africa and Tanzania"

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IMPLICATIONS OF INTELLECTUAL PROPERTY RIGHTS FOR THE ACCESS TO AND USE OF INFORMATION TECHNOLOGIES IN DEVELOPING COUNTRIES

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INTRODUCTION

The diffusion of technologies has been extensively studied in the economic literature (see OECD 1992). Though these studies have considered many factors that may influence the rhythm and modalities of adoption of technologies, the possible impact of legal factors, particularly intellectual property rights (IPRs), has been only incidentally addressed.

The purpose of this paper is to examine recent developments in intellectual property law and the ways in which they may affect the diffusion of Information Technologies (ITs) in developing countries. Analysis and discussion will be centred around the barriers that IPRs may create for the access and use of ITs in such countries. The paper also addresses the main issues that arise, with regard to access to information as such, as a result of the digitisation of data and the development of large computer networks or "information highways".

The problems related to access and use of ITs are considered here with regard to the application of ITs for production of hardware/software as well as with respect to their use.

While economic reasons are behind major changes in law, the latter also has a definite influence on the economy. The interaction between law and economics is complex. It is often very difficult to isolate the "legal factors" and measure their impact on economic decisions. However, rules created by law establish implicit prices for different kinds of behaviour, and the consequences of those rules can be analysed as the response to those implicit prices (Cooter and Ulen 1988).

The relationship between IPRs and the economy has been addressed from different perspectives (Correa 1994a). During the 1970s, the impact of IPRs particularly patents on developing countries received some attention from scholars. Initiatives to develop new international rules that take into account the interests of such countries were also launched, albeit with little success. (This was the case of the initiatives to revise the Paris Convention, and to establish an International Code of Conduct on Technology Transfer.)

More recently, particularly after the launching of the Uruguay Round (1986), economists' interest in IPRs has revived, as illustrated by work done by the World Bank (see Siebeck et al. (1990), David (1993), Mansfield (1993, 1994), UNCTAD (1996), Correa (1995)).

This paper briefly considers changes in the paradigm of protection of IPRs, particularly in the areas of patents and copyright (Section 1.1). It describes the nature and scope of the standards of protection negotiated during the Uruguay Round (Section 1.2), and new developments in progress (Section 1.3).

The relationship between information technologies (ITs) and intellectual property rights (IPRs) is examined with respect to computer programs (Section 2.1), including the trends in the areas of multimedia products (Section 2.2) and integrated circuits (Section 2.3). Issues related to the protection of and access to databases and digital information in general are dealt with in Section 2.4.

The implications of the trends described for the access, acquisition, and use of ITs in developing countries are considered in Section 3.1. Sections 3.2 to 3.5 analyse the impact of copyright, patents, and integrated circuits protection with regard to the production and use of ITs, as well as to the access and use of digital information. Section 4 includes the main conclusions of the study.

1. THE PARADIGM OF IPRS PROTECTION

1.1 Changes in Patent and Copyright Law

The IPRs system has dramatically changed in recent times. As a recent study notes: "The ongoing shift toward a global, knowledge-based economy has resulted in the law and economics of intellectual property rights changing more in the last five years than in the last two centuries" (Acheson and McFetridge 1994: 239).

Under the original patent system, explains Merges, society's benefit "was the introduction of a new art or technology into the country". By the late eighteenth century, however, a major change in the economic role of patents took place, shifting the emphasis from the introduction of finished products into commerce to the introduction of new and useful information. The "primary benefit was seen as the technological know-how behind the inventor's patent. The beneficiaries on this view were not just the public at large, but instead others skilled in the technical arts who could learn something from the patentee's invention" (Merges 1992: 6).

During the present century, a new shift in emphasis took place towards a system mainly concerned, on the one hand, with the encouragement of investors rather than of inventors, and, on the other, with the commercialisation, on an international scale, of protected goods and services. Changes in the patent system reflected the growing internationalisation of the economy and, particularly, the interest of large industrial corporations in being able to flexibly select the channels for the world-wide exploitation of their innovations, through trade, technology transfer, or foreign direct investments (Penrose 1951).

Several factors contributed to prompt during the last decade a far-reaching reform of the intellectual property system. These relate to the increase in research and development (R&D) costs, the shortening of the life-cycle of products, difficulties in appropriating R&D results, particularly in the field of easy-to-copy new technologies (such as computer programs), and the globalisation of the economy (Correa 1994b; David 1993).

Under the currently dominant conception, it is assumed that by making products available (which would not occur, by hypothesis, without protection) and stimulating investments in research, society is fully compensated for the monopoly it grants. Some U.S. court decisions reflect this approach: in Platex Corp v. Missinghoff (758 2d 594, 599, Fed. Circ. 1985), for instance, the court stated that "the encouragement of investment-based risk is the fundamental purpose of the patent grant".

A similar transformation has taken place in the copyright field. The original intent of copyright law in the United States was described by the Supreme Court in a famous case (Wheaton v. Peters), as follows:

The enactment of copyright legislation by Congress under the terms of the Constitution is not based on any natural right that the author has in the writings, for the Supreme Court has held that such rights as he has are purely statutory rights, but on the ground that the welfare of the public will be served and progress of science and useful arts will be promoted. Not primarily for the benefit of the author, but primarily for the benefit of the public such rights are given. *(OTA 1986: 38)*

This model assumed that "by granting economic rights to the creator of intellectual works, information would be created and disseminated, and thus a number of other social and economic objectives would be achieved. In this model, not only were other societal goals understood to be furthered by fostering the learning environment, these goals were also seen to be mutually compatible and self-enforcing" (OTA 1986: 56).

A new conception has developed, however, in the field of copyright. There has been a fundamental shift from a system based on non-commercial considerations the benefits that the society will derive from creative authorship and the dissemination of ideas to a "law of misappropriation" the ultimate objective of which would be to protect the commercial value of creative outputs. The encouragement of investment and the availability to the public of their results would be sufficient, in accordance to said conception, to justify the awarding of monopoly positions[1]. "Whatever copyright may have rested upon in the past, the primary goals of copyright are now economic considerations" (Swanson 1988: 224) (see also Dreyfuss 1987).

[1]For instance, a U.S. Supreme Court decision (Mazur v. Stein), stated that "the economic philosophy behind the clause empowering Congress to grant patents and copyrights is the

1.2 The TRIPs Agreement

An outstanding illustration of the new emerging paradigm on IPRs is provided by the Agreement on Trade-Related Aspects of Intellectual Property Rights (the "TRIPs Agreement"), which was negotiated in a trade-forum GATT to address the economic, trade-related, aspects of IPRs. This Agreement represented a "conceptual leap" and a major achievement of U.S. industrial groups that have advocated linking IPRs to trade issues since the early 1980s (Sell 1995), in order to exert pressure on foreign countries to adopt higher standards of IPRs protection.

Negotiations on the TRIPs Agreement were initiated by request of, and under strong pressure from, industrialised countries. Their objective was to establish minimum standards, with regard to substantive as well as to procedural rules, with a universal application, on practically all areas of intellectual property. Developing countries reluctantly negotiated such standards, but finally agreed to make important concessions in terms of future reforms of their intellectual property legislation.

The initiative to negotiate the TRIPs Agreement can be explained, on the one hand, by the effective action of industrial lobbies (particularly the pharmaceutical, software, semiconductors, and phonograms industries) and, on the other, by the changes in intellectual property law occurred in response to new technologies.

The TRIPs Agreement sets forth the minimum standards to be applied by all Members of the WTO. Such standards are, at the same time, the upper limit that many countries are prepared to accept. This is reflected, for instance, in the recent Argentine patent law (1995).

If a WTO Member does not observe the prescribed minimum standards, no other Member can unilaterally apply trade sanctions against that Member, as provided for, for instance, under section 301 of the U.S. Trade Act. Any complaint must be brought to and dealt with under the multilateral procedures established by the Dispute Settlement Understanding (DSU).

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conviction that the encouragement of individual effort by personal gain is the best way to advance public welfare through the talents of authors and inventors." (247 U.S. at 219)

There are a number of areas where the TRIPs Agreement has left freedom to legislate, where further harmonisation of IPRs protection does not seem possible or desirable. This includes many aspects of authors' rights/copyrights and of industrial property law.

This freedom can be effectively used by any country to develop legislation in accordance to article 7 ("Objectives")[2] and article 8 ("Principles")[3] of the Agreement, which provide for a pro-competitive framework to implement IPRs protection.

The concepts of "mutual advantage", "social and economic welfare", and "balance of rights and obligations" in article 7 mean that the recognition and enforcement of intellectual property rights are subject to higher social values and, in particular, that a balance needs to be found with other users of technological knowledge.

Under these provisions, national legislation can provide for a variety of measures that promote competition and balance, to some extent, the interests of the title-holders with those of the users of the technology. Such measures may include parallel imports; non-patentability of substances existing in nature and of animals and plants; compulsory licenses of various types;[4] and reverse engineering of computer programs, among others.

In the area of ITs, the TRIPs Agreement contains several important provisions:

[2] Article 7 states that: "The protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conductive to social and economic welfare, and to the balance of rights and obligations".

[3] Article 8 states that: "(1) Members may, in formulating or amending their national laws and regulations, adopt measures necessary to protect public health and nutrition, and to promote the public interest in sectors of vital importance to their socio-economic and technological development, provided that such measures are consistent with the provisions of this Agreement. (2) Appropriate measures, provided that they are consistent with the provisions of this Agreement, may be needed to prevent the abuse of intellectual property rights by right holders or the resort to practices which unreasonably restrain trade or adversely affect the international transfer of technology".

[4] It should be noted that the TRIPs Agreement does not limit (except for semiconductor technology) the grounds under which compulsory licenses can be granted, but only defines the conditions therefore.

- Computer programs, whether in source or in object code, are to be protected as "literary works" (article 10.1).
- Protection of computer programs shall last at a minimum for fifty years, and shall include exclusive rights to rent the programs ("rental rights", article 11).
- Compilations of data (databases) shall be protected under copyright, provided that they constitute an intellectual creation due to the selection or organisation of materials (article 10.2).

Finally, it should be noted that all WTO Members within one year after the date of entry into force of the WTO Agreement (1.1.95) agree to apply the obligations relating to intellectual property protection (article 65.1). Developing countries have an additional period of four years and least developed countries of ten years, except for obligations concerning national and most-favoured-nation treatment, which will become applicable after the expiry of the aforementioned one-year period.[5] Enjoyance of these transitional periods does not require any specific declaration or reservation by the concerned country. They are automatically applicable.

The establishment of these periods was not a generous concession by industrialised countries. It was the result of hard negotiations in which developing countries obtained, in exchange, long transitional periods for complying with their obligations in agriculture and textiles. In other words, the transitional periods in TRIPS had a "price" and a high one for developing countries, in terms of export losses in agriculture and textiles.

Transitional periods are nevertheless essential for many developing countries, which need time to introduce new legislation and adapt the affected economic sectors to the new regulatory framework.

The United States is, however, threatening several developing countries with sanctions under section 301 of the U.S. Trade Act. It requests, among other things, not only immediate introduction of the TRIPs standards but their retroactive application (under the so-called "pipeline" solution).

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[5] In addition to the general transitional periods referred to above, a further period of five years is contemplated for countries which are bound to introduce product patent protection in areas of technology not so protected in their territory on the general date of application of the Agreement for that country (Article 65.4)

Such a request is completely illegitimate under the TRIPs Agreement. It disregards binding international rules, and deprives developing countries of their right to take the necessary time to introduce legal reforms and adopt measures that mitigate the eventual negative economic and social impact of the standards.

To sum up, the adoption of the TRIPs Agreement represented a major victory for industrialised countries and their most active industrial groups. The Agreement, however, contains a number of elements of flexibility that allow under certain limits the development of a pro-competitive approach towards intellectual property.

1.3 New Developments

Further changes seem under way in the IPRs system. On the one hand, the incremental nature of innovation in key industries, such as electronics, is not well captured by existing rules, and may lead to a crisis of the current model of IPRs protection. According to Foray:

Innovative activity has shifted away from models based on absolute novelty and first improvement towards a model in which innovation is no longer driven by technological breakthroughs but by the routine exploitation of existing technologies. This change has precipitated a crisis in the area of intellectual property rights, particularly in the sectors where the new innovation model is most wide-spread (biotechnology, software, consumer electronics). (Foray 1995: 120)

On the other hand, the need to extend IPRs protection to "information products" which are not copyrightable, patentable, or subject to other existing IPRs has been voiced. It is recognised that "fact and functional material" are the building blocks upon which scientific and technological progress depends, and that their content is so closely tied to facts and laws of life and nature that there is little room for creation (Dreyfuss 1993: 196, 214).

However, it is argued that determining what information the market wants and conveying that information clearly and in appropriate formats can require a high level of ingenuity. In addition, "lead time" which allowed in the past to recover the investments made for the generation of new knowledge has shortened or vanished. A new, eventually "hybrid" form of protection would be,

according to some experts and industry views, required in order to provide the adequate incentives to innovate (Dreyfuss 1993: 210, 234; Samuelson et al. 1994)

This changing approach on the IPRs regimes reflects itself in two major developments:

- Expansion of the subject matter of protection. New areas of knowledge are becoming subject to property rights. One outstanding example is the protection of semiconductors' layout designs under a new, *sui generis*, system of protection, established for the first time in the United States in 1984. An international obligation (under the TRIPs Agreement) to protect such designs has been already adopted.

Patents have been extended in most countries to living matter, including plants and animals, though this still causes considerable debate (Crucible Group 1994). As discussed below, the granting of patents on computer programs is currently admitted in the United States.

A new form of *sui generis* right has been also developed within the European Union in order to protect investments made for the development of databases that are otherwise unprotectable under copyright (see Section 2.4.1 below).

- Universalisation of minimum standards of protection. Under the principle of national treatment, each country could frame in the past its intellectual property system in accordance with its own needs and long-term interests, provided that it granted foreigners the same treatment accorded to nationals. However, the adoption of minimum standards under the TRIPs Agreement (including such aspects as definition of protected subject matter, terms of protection, extent of exclusive rights, etc.) has reduced national freedom and increased to an unprecedented level the degree of universal harmonisation of IPRs (see Frischtack 1995).

This process means, in particular, that developing countries are bound to incorporate standards of protection basically in accordance with those so far in force in industrialised countries.

Even though a new international intellectual property regime could be "Pareto improving", it is likely "to impose institutional arrangements that may be well adapted to the national purposes and legal contexts of one country (or several similar countries) on societies that are quite different in those respects" (David 1993: 55).

In sum, intellectual property law has substantially evolved in response to changes in technology and market trends. The emerging system is centred on the economic dimensions of intellectual property rights. The primary concern is rewarding investors, rather than the encouragement of individual creation and the public dissemination of knowledge: “even if the rhetoric of argument occasionally appeals to notions of justice and equity, modern economic analysis, and its characteristic preoccupation with questions of efficiency, now set the terms for policy discussions about the protection of intellectual property” (David 1993: 20).

2. ITS AND INTELLECTUAL PROPERTY LAW

The development and rapid diffusion of information technologies has posed major challenges to various aspects of public and private law. The birth of new products and of whole new branches of industry, such as semiconductors, computers, computer software, multimedia, and databases, has called for the adaptation or creation of new legal principles and rules.

Pre-existing rules and institutions of intellectual property have been deemed applicable to some of the new areas, with certain adjustments. This is, for instance, the case of computer software: following a number of precedents established by national laws, computer software has become protectable under copyright as literary work. The TRIPs Agreement has explicitly obliged all Member countries to adopt that approach. Though this has proven the adaptability of copyright to new situations, the outcome does not seem to satisfy everybody considerable debate still goes on due to the functional character of software and its problematic assimilation to literary works (see Samuelson et al. 1994).

In other areas, as in the case of semiconductors, new legal approaches have been developed. Based on the regime adopted by the United States under the Semiconductor Chip Protection Act of 1984, countries which thereafter legislated on the matter have followed the *sui generis* approach first established by that Act, which also influenced the Washington Treaty concluded in 1989.

Though these and other regulations, and case law, addressed many of the emerging issues, technological developments have continued to pose new and increasingly complex problems to intellectual property law. One of the main directions of such developments has been the convergence of different types of applications, based on the common infrastructure provided by digital technology.

Digitised text, speech, graphics, images (moving or not), music, and sound can be combined using appropriate computer software and associated hardware. This combined use gives rise to a

wave of new products and services with an expanding market. The products may be either fixed in material form (such as CD-ROM) or stored and directly accessible on-line as digital data.

2.1 Protecting Computer Programs

2.1.1 Technologies for Software Development

Technologies for software development are not proprietary, although the use of certain tools, platforms, or interfaces may require the negotiation of a license and the payment of royalties. Different languages and architectures offer software producers options to develop their products, with different technical (and commercial) advantages and disadvantages.

Technology for software development is largely available at university and research institutions. The basic knowledge to create computer programs is accessible to individuals of various disciplines (not necessarily software specialists) with a mathematical background. The nature of software technology from time to time permits outsiders to challenge the market position of major software producers, a few of whom dominate the market. ("Linux" provides a good example.) Due to these characteristics, software has been deemed a strong candidate for "leapfrogging" by developing countries that posses a good scientific infrastructure (Pérez 1987).

The knowledge involved in software development, however, constitutes a more complex technology where other skills (relating to, e.g., information systems, hardware architectures, project management, etc.) are required, depending on the type of software to be produced. Besides, as argued elsewhere (Correa 1996), availability of technology is not enough to overcome the formidable commercial entry barriers prevailing in the software market.

Innovation in software development is typically incremental (Samuelson et al. 1994: 2,330). Software products are generally developed using previously existing programs and algorithms. Software is a "cumulative systems technology", as opposed to the "discrete invention model". It is a "technology that builds on and interacts with many other features of existing technology to create a new technology" (Nelson 1994: 2,676-77).

Though software development is subject to the limits imposed by the particular problem to be solved, there is no unique way of developing a certain product. Software producers make strategic choices, taking the type of products and markets envisaged into account.

Considerable room is, hence, left for creativity and ingenuity. Tacit knowledge, based upon experience, plays an important role in software development, which may be described despite the introduction of software engineering tools as still being an "amateurship, craft-based discipline" (Cane 1992: 1,726) rather than a proper "industrial" activity (Zimmermann 1993).

2.1.2 Copyright Protection

Copyright has been applied to computer programs, with some hesitation at the beginning, and with a lot of still ongoing controversy about the extent of protection. By pushing the copyright way, United States government and industry strategically opted for a form of protection which is cheaper to obtain than industrial property rights, that does not require disclosure, and, above all, that permits almost universal and automatic protection without registration, from the very date of creation of the program.

This latter feature is of utmost importance for any internationalised industry, such as the software industry. Copyright protection does not require applications and procedures in individual countries. It has practically a global reach as a result of the large membership of the Berne Convention.

The recognition of computer programs as a copyrightable work was actively sought by major software producers and the United States government. Under section 301 of the Trade Act, the United States Trade Representative (USTR) initiated several procedures against developed and developing countries that did not adequately protect, in USTR view, such programs. The cases of Brazil (Bastos 1995), Thailand (where a government was forced to step down due the reaction created by its attempt to accept U.S. pressures in the software area see (Correa 1990a)), and, more recently, China, are illustrative of such actions.

The pro-copyright campaign also reached GATT. The TRIPs Agreement clearly states that computer programs are to be protected "as literary works". This provision entails the internationalisation of a legal framework of protection for computer programs, on the adequacy of which doubts continue to be voiced (Samuelson et al. 1994). The functional aspects of computer programs pose difficult questions that copyright law has so far been unable to resolve (OTA 1992: 22).

Copyright only protects the expression of an idea, not the idea as such. This basic dichotomy contained in U.S. copyright law has been explicitly stated in the TRIPs Agreement (article 9.2).

As a result of said dichotomy, the production of an identical copy of a program is prohibited by law, if it is the result of access to the pre-existing program. There is no infringement if an identical program is independently created without such an access. Likewise, there is no infringement if a program has the same behaviour but a different expression, even if the new program has been created on the basis of access to and reverse engineering of a pre-existing one.[6]

It should be noted, finally, that computer programs, are not only protectable as copyrightable works. The "source programs" can also be protected as trade secrets or undisclosed information. Such programs contain the most valuable information for software producers, information not made available to the public through the distribution of copies in magnetic form.

In sum, copyright protection (as supplemented by trade secrets protection) erects barriers against imitation and competition via incremental innovation, but it presents important shortcomings for those looking for stronger means of preventing the development of competitive products via reverse engineering (Correa 1993). Different ways have been utilised, particularly by major software producers, to neutralise the weaknesses of existing IPRs protection. These have included extension of the scope of, and search for new forms of, IPRs protection, and strict and aggressive enforcement of available IPRs.

[6] It is debated, however, whether a "substantially similar" imitative program is infringing or not (Kitagawa 1994: 2,613).

2.1.3 Extending IPRs Protection

Beyond expression. A large number of cases (see Box 1) were brought to courts in the United States in order to obtain copyright protection of user interfaces ("look and feel"), a crucial aspect for the development and marketing of competing products.

"User interfaces" determine the way in which a user interacts with the computer through the use of "menus", certain forms of entering commands, etc. External consistency of a new program with an existing one permits "transfer of learning", and therefore increases the likelihood of adoption by potential users, who may be reluctant to invest time in learning how to use new programs.

Protection was recognised for the overall set of command terms and their organisation into menus, the menu "structure", the order of commands in each menu line, and the choice of letters, words, or "symbolic tokens" (OTA 1992: 143).

Unsuccessful demands for protection of "user interfaces" included particular menu styles, the use of pull-down menus, the use of a two-line moving cursor, and ways of entering commands, among others.

Box 1
Limiting competition on expressive elements of computer programs

Suits against competitors have been due to their copying of expressive elements of computer programs, including the following:

Placing screen captions at the top centre of the screen
Using the colour blue as screen background
Designating which keystrokes a user should press to enter the program function that a given
Screen menu word designated by capitalising and highlighting (making brighter) the letters of
The menu word corresponding to the keystrokes
Labelling the opening menu of a program as "Opening Menu"
Use of pull-down menu windows in reverse video
Use of the same command language to operate program functions that the plaintiff's earlier
Program used for those functions
Having the same switch patterns on a machine's front panel to actuate the machine's software
Imitating the plaintiff CADAM's computer program by being "too CADAM-ish".

Source: Stern 1993: 39.

Limiting reverse engineering. Innovation in the software industry is very dependent, as mentioned before, on the improvement of existing products. Development costs can be significantly reduced by evaluating products on the market and designing new products with enhanced features. A crucial aspect for innovation and competition in the software industry is, therefore, the extent to which the evaluation (reverse engineering) and improvement of computer programs are feasible and legitimate.

In contrast to the tacitness present at the production phase, software products are fully formalised and codified. This affects the appropriability of the results of development work, since much of the embodied know-how is "borne on the face" of the product (Kitagawa 1994: 2,615). Other embodied elements of the know-how may be obtained through decompilation and disassembly.

"Decompilation" and "disassembly" are technical procedures that permit the reverse engineering of software products. "Decompilation" allows one to translate a machine language program into a high-level representation program, i.e., a more understandable form. By "disassembly", a machine language program is translated into an assembly language program (OTA 1992: 146). Though such procedures are useful for small products, this is not necessarily the case for large ones, at least under the current state of the art, since decompilation in the latter case is extremely costly and time-consuming (Samuelson et al. 1994: 2,336, 2,341). This provides a *de facto* protection to innovators against imitation.

In principle, under the idea/expression dichotomy, reverse engineering is a legal method of acquiring knowledge of the internal organisation and structure of a program, with a view to producing a new program differently expressed. Reverse engineering is also legitimate with regard to trade secrets, except if unfair practices are used to obtain the relevant knowledge (Neff and Smallson 1994: 102).

The admissibility of the reverse engineering of computer programs has set off, however, a heated debate and hesitant case law.[7] Major U.S. firms and the U.S. government have strongly lobbied to limit that activity.[8]

Thus, when the European Commission decided to clarify, by means of a specific Directive, the scope and extent of protection of computer programs, major software producers who are able to determine *de facto* market standards campaigned for the restriction of reverse engineering in this field. They confronted other firms (including ones from Japan, the United States, and Europe[9]) that regarded the prohibition of reverse engineering as a potentially insurmountable barrier to competition.

As an outcome, European Council Directive 91/250 on the Legal Protection of Computer Programs set out a compromise: reverse engineering was deemed legitimate only if it was intended to achieve "interoperability" with the evaluated program. The Directive permitted decompilation when it was "indispensable to obtain the information necessary to achieve the interoperability of an independently created program with other programs" (article 6).

One important manifestation of the trend toward extending protection of computer programs, even within the framework of copyright law, was United States case law holding that such a protection could embrace not only the literal code (expression) of a program, but also its "structure, sequence, and organisation" (Whelan Assoc. v. Jaslow 1987). This extended protection was, however, denied in subsequent decisions (Atari v. Nintendo; Sega v. Accolade, 1992). In Sega v. Accolade the court held that:

Where disassembly is the only way to gain access to the ideas and functional elements embodied in a copyrighted computer program and where there is a legitimate reason for seeking such access, disassembly is a fair use of the copyrighted work as a matter of law.

[7] In NEC Corp. vs. Intel Corp. (67.434 (N.D. Cal. Feb. 6, 1989), for instance, a U.S. court did not condemn the disassembling of an Intel microcode (8086/88 microprocessor chips) for the purpose of researching and developing a competitive microcode program.

[8] U.S. action blocked the explicit legalization of reverse engineering in Japan (Kitagawa 1994: 2,617).

[9] A group of these firms constituted the "European Committee for Interoperable Systems" to lobby in favor of decompilation to get access to unprotected elements.

The possible negative impact on innovation of an eventual limitation to reverse engineering, has been pointed out by many scholars, who warn that overprotection can not only stifle creativity but also limit developing countries' access to technology (see Mody 1989: 2, 34).

Applying for patents. Despite the efforts made to extend the rights conferred by copyright protection, dissatisfaction of major producers has continued. The difficulty of appropriating the functional aspects of a program and the need to prevent reverse engineering have prompted a growing use of the patent system, notwithstanding the high inventive standards and the required disclosure of the invention.

Two categories of software-related inventions may be distinguished: (a) computer programs that produce a technical effect within the computer or on other hardware components; and (b) computer programs that produce technical effects different from those described in (a), entailing changes in the state of physical matter, such as effects on equipment applied to a specific industrial task (Guglielmetti 1996: 70).

In the United States, the possibility of obtaining patents on computer programs has found a favourable attitude from the Patent Office and case law. Since the decision in the leading case Daimond v. Diehr until 1994, more than 3.500 software patents have been granted (Warshofsky 1994: 162).

U.S. courts distinguished non-patentable, purely mathematical algorithms from inventions in which such an algorithm is "applied". In Diamond v. Diehr, a patent on an algorithm used to control a process for curing rubber was upheld. However, patents have also been granted in cases where there is no transformation of physical substance into a different physical state, and only manipulation of data is involved. Some examples of granted patents (including both categories defined above) are given in Boxes 2 and 3.

Attempts have been also made to claim protection on computer languages. Adobe, for instance, "a software house that created a popular desktop publishing program, claims that its PostScript language is copyrighted, although it has not sued those who reject this claim" (Warshofsky 1994: 152).

The Arrythmia case (958 F.2d 1053 (1992)) is illustrative of current trends in the United States. The invention involves a formula that analyses heartbeat signals, assigns an arithmetic value to the analysis, and compares that value with a predetermined level. The comparison allows a diagnosis as to whether the individual tested is at risk for heart failure. While the Court reiterated that inventions consisting solely of an abstract mathematical formula or equation are not patentable, it stated that the patent claims did not result in patenting a mathematical formula, but "only foreclosed others from using that formula in conjunction with the diagnostic and computer-run steps of the particular invention" (Fishman 1994: 5/32).

Software patents to the extent that, unlike copyright, they protect ideas, and not their expression may have important implications, independently from the technical importance of the involved "invention".

Box 2

Examples of software patents granted in the United States

The patented invention:

translates between natural languages.
determines boundaries of graphic regions on a computer screen.
governs removable menu windows on a computer screen.
generates and overlays graphic windows for multiple active program storage areas in the com puter.
qualifies and sorts file record data in a computer.
compresses and manipulates images in a computer.
handles the data structure and search method for a database management system.
automates spelling error corrections as in some form of a spell-checker system.
set up a securities brokerage cash management system.
operates a system that values stocks, bonds, and other securities
automatically makes a two-dimensional portrayal of a three-dimensional object; specifically, it
transfers a 2-D drawing of an object into a computer-presentable 3-D drawing.
allows information to be stored on a hard drive and retrieved by multiple users at different locations.
measures the performance of a general purpose digital computer.

Source: Fishman 1994: 5/22, 5/23.

Box 3

Patenting prime numbers

A troubling case has been identified by the British Parliamentary Office of Science and Technology: a patent on prime numbers. "A patent was issued by the U.S. Patent and Trademark Office (PTO) for a mathematical method (the Partial Modular Reduction Method) which is of use in cryptography and security systems. The claims included the use of two prime numbers (comprising 150 and 320 digits) which have a property that speeds up decryption. Indeed, the claim in the patent extends to using any prime number that allows the short cut to be made. The U.S. PTO agreed that the two prime numbers in the claim represent novel discoveries that have some utility, and can, therefore, be patented under U.S. patent law".

Source: Parliamentary Office of Science and Technology 1996: 33.

Thus, Warshofsky reports that Cadtrak Corporation applied for a patent on a computer screen display and included the exclusive-or statement as one of 15 claims. "They were granted U.S. Patent No. 4,197,590, and as a result, anyone who wants to put a cursor on a computer screen either pays Cadtrak or runs the infringement gauntlet. More than 300 hardware and software companies, including IBM, Texas Instruments, and Fujitsu, chose the easy way and are paying royalties to license that single patent" (Warshofsky 1994: 164).

In another case, "Paul Heckel, a California programmer, was granted U.S. Patent Nos. 4,486,857 and 4,736,308 for a system that displays records or strings of information and then allows the operator to scroll, or browse, through them. Heckel sued Apple computer, alleging their HyperCard program violated those patents. Despite the fact that scrolling and sub-windows, the techniques incorporated in the patents, were quite well known, using them in combination may now be considered illegal. Rather than fight what is considered a nuisance suit, Apple simply took out a license" (Warshofsky 1994: 163).

In Europe, the patenting of computer programs has been less permissive than in the United States. The European Patent Convention forbids the patenting of computer programs as such. Patents have not been granted in cases where the program only undertakes mathematical operations, analyses test data (e.g., application by Siemens, 1989), or permits the graphic presentation of data (IBM, 1993), among others. In exchange, computer programs that generate a transformation in physical reality by guiding the operation of other means have been deemed patentable, such as a computer-operated radiological device (Koch & Sertzel, 1987), and a system to automatically manage the order of the supply of services to clients at different sites (Queuing System, 1994) (Guglielmetti 1996: 78-89).

Enforcing IPRs. Several cases illustrate how aggressively and extensively IPRs may be enforced. One example was the IBM-Fujitsu case relating to the infringement of IBM's software. IBM obtained from Fujitsu a compensation for infringement amounting to US$833 million, plus annual royalties between US$26 and 51 million. The arbitration process, however, determined that Fujitsu should have to be allowed continued access to IBM's software (Mody 1989: 34).

Further, major software producers have individually or jointly (through the "Business Software Alliance") undertaken "anti-piracy" campaigns and brought judicial action against distributors of "pirated" software, as well as against corporate users that did not respect contractual or legal restrictions (particularly those preventing the making of copies other than for back-up purposes).

The piracy levels reported by interested groups are high in both developing and developed countries (see Table 1). Though the basis and mode of calculation of these estimates is unclear, they reflect the concern with what seems to be a widespread phenomenon. It is almost impossible to monitor and prevent private copying of computer programs. Litigation costs are disproportionately high to prosecute individual users or small firms.

In the case of Latin America, legal actions have been initiated against large local (private and public) companies and foreign subsidiaries, as well as against public research institutions[10]. Their aim has mainly been to give a signal to major software users in order to discourage illegal copying.

[10] In some cases, software suppliers have made global arrangements with universities in order to allow the legal distribution, at low cost, of copies of old versions of computer programs.

Table 1 U.S. Computer Software Industry Losses due to piracy, and levels of piracy (1995)

Region	U.S. Losses (in US$ millions)	Piracy Level (%)*
Asia	2,542	78
Western Europe	3,001	52
Central & Eastern Europe	619	92
Middle East & Mediterranean	300	93
The Americas & Caribbean**	1,074	86
United States	2,358	35
Total	9,894	---

* includes data for the world's business software industry, not just the U.S. industry
** includes Canada but not the U.S.
Source: Smith 1996.

2.2 Multimedia Products

The development of multimedia products involves a variety of knowledge and skills, and often the combination of pre-existing works developed by different authors. Producers of multimedia integrate multiple technologies and works in a creative form. Producers' skills are required to select the materials and to determine the form in which they are organised and presented in an interactive way.

Multimedia producers may be divided in four categories:

- professional video producers, including TV producers;
- industrial producers, such as corporate graphics and video producers in advertising;
- commercial organisations that produce their own multimedia material;
- educational institutions and educators (Buckner 1995: 33).

As a result of the complex nature of multimedia products, a "package" of intellectual property rights, belonging to the same or different title-holders is involved. Such rights include:

- Copyrights and related rights. Authors of text, computer programs, databases, music, photographs, and motion pictures as well as performing artists may claim copyright and related rights with respect to the works partially or totally included in multimedia products.

Those rights should be differentiated from those belonging to the multimedia producer as such, i.e., to the person or persons who have combined the various components in an original form.

The multimedia producer may develop by himself the different components of the product or may use existing works. The latter is the most common situation. The multimedia producer needs in this case to obtain permission from each author to use the respective work.

Obtaining permission and determining the remuneration to be paid to all possible title-holders involved is one of the outstanding problems in the area of multimedia. It may be extremely difficult to determine authorship and to contact all possible authors, as well as to evaluate the level of the remuneration to be paid. Transaction costs are high.

- Patents. Patent law may also apply to multimedia products, though in a limited and, probably, controversial way.

A patent granted to Compton New Media in the United States is an example of the possible extension of patents to the multimedia world. Compton New Media obtained a patent for a computer-controlled system for retrieving text and images from a database and claimed a 1% royalty from companies producing interactive multimedia products. The patent created wide concern in industry. It was successfully challenged and finally overturned (Keck 1995).

- Trade secrets. Finally, as in the case of computer programs, trade secrets may also be relevant for multimedia products. The source-code of computer programs, as mentioned above, is generally deemed to be protected by trade secrets, in addition to copyright.

The production of multimedia is one of the opportunities that developing countries might try to exploit. However, legal issues are so intricate and complex, that unless a general solution is implemented (e.g., by means of compulsory licensing), transactions costs for obtaining all required authorisations may be prohibitive and block any possible significant development in this field.

2.3 Integrated Circuits[11]

The semiconductor industry is highly concentrated. A few transnational corporations account for the overwhelming share of semiconductor production and trade and for the technologies necessary for state-of-the art semiconductor manufacture. Among developing countries, only South Korea has emerged as a world-class competitor. Taiwan has also developed some

[11]This section is partially based on (Correa 1990b).

capacity. Other developing countries participate as exporters of semiconductors locally assembled by subsidiaries of transnational corporations. The high investment required for mass chip production and the intensity and cost of R&D in an extremely competitive market constitute formidable barriers for potential new entrants, particularly from developing countries.

While the production of integrated circuits is beyond the reach of most developing countries, the design, particularly of custom and semicustom chips, has been undertaken in many of them, particularly in new industrialising countries (NICs). This has been facilitated, on the one hand, by the development of CAD tools that can run on relatively small-size computers, and, on the other, by the possibility to contract with various silicon-foundries the manufacture of a chip according to independently-made designs.

Technological advance in the semiconductor industry is an interactive, cumulative process where improvements are directly based on the pre-existing stock of knowledge. Studies on the role of IPRs in promoting innovation in this industry have shown that gaining lead time and exploiting learning curve advantages are the primary methods for appropriating the returns of investments in R&D (Levin et al. 1987: 788).

The protection of layout designs of integrated circuits as a specific subject matter was born in the United States in 1984, with the approval of the Semiconductor Chip Protection Act (SCPA). The growing concern on the decline of U.S. competitive advantages in chip production and trade during the 1980s prompted Congress to adopt a *sui generis* protection.

It was assumed, in particular, that the increasing strength of Japanese firms was linked to the copying of American designs.

The *sui generis* regime for integrated circuits established under the SCPA provided for a ten-year protection; registration was made compulsory within two years of the first "commercial exploitation" of a mask work; a special provision allowing for "reverse engineering" was contemplated, following the practices prevailing in the semiconductor industry.

The SCPA, in addition, included stringent reciprocity rules that forced Japan to adopt similar legislation ("Act concerning the circuit layout of a semiconductor integrated circuit" (law No

43), followed by the European Communities (Council Directive on the legal protection of topographies of semiconductor products 87/54/EEC)).

The World Intellectual Property Organisation (WIPO), shortly after the enactment of the SCPA, initiated studies and consultations in order to establish an international treaty on the matter, based on the *sui generis* approach. Negotiations led to the adoption, in 1989, of the Washington Treaty. The United States and Japan, however, did not sign it, due to disagreements with respect to compulsory licenses, the treatment of innocent infringement, and the protection of designs when they are incorporated in industrial products. These perceived shortcomings were expeditiously addressed a few years later. The TRIPs Agreement practically derogated the Treaty provisions that had been rejected by the two chip-powers, and added those obligations that they felt were missing.

So far, very few developing countries, such as South Korea and Taiwan, have considered legislation to specifically protect integrated circuit designs, but all WTO Member Countries are obliged to do so.

One of the main reasons for the enactment of the SCPA and of its internationalisation was the alleged copying of original chip layout designs, particularly by Japanese competitors. However, the very little litigation that took place on the basis of that regime would indicate that the copying of chip layout designs was not the main battlefield[12].

The main purpose of the *sui generis* regime on integrated circuits is to prevent copying of original chip designs, and the commercialisation either of the infringing chips or of the products that incorporate them. As mentioned, the *sui generis* regime does not prevent reverse engineering.

The important controversies did not relate to the layout designs, but to technical ideas underlying them that may obtain patent protection. Thus, Texas Instrument was reported to have earned (by 1994) more than US$1.5 billion in royalties from its patent portfolio. Its main source of income was a broad patent originally filed 30 years ago “covering an old-fashioned technology that has been extended by peculiarities unique to the U.S. patent system”. Intel also

has an aggressive IPRs strategy, with a litigation budget of at least US$100 million, that few companies can match. Based on its patent U.S. 4.338.675 it has attempted to bar competition not only from other major chip producers, but also from small design houses (Warshofsky 1994: 252, 256).

Action by Texas Instruments reached competitors world-wide. It sued seven Japanese companies on the same charges at the same time, which have reportedly paid an average of around US$30 million per firm. Samsung was also sued, but it paid over US$90 million. The reason of this different outcome seems to be that Japanese firms held "several patents of their own ad were able to negotiate cross-licensing agreements and thus lower the amount of royalty payments to Texas Instruments" (Mody, 1989, p. 38).

2.4 Digital Information

The current trends in IPRs may, finally, affect access to information. As mentioned above, there are attempts to extend protection to factual materials that are unprotectable under existing IPRs. Some authors (Catala 1984) argue for the application of property rights to such. Even if such theories are rejected, developments with regard to databases and information in "cyberspace" may lead to similar effects, i.e., restraining or excluding access to and use of information, even if unprotectable under IPRs.

2.4.1 Databases

Databases are protectable, under copyright, as compilations. In principle, however, only those databases that meet the copyright originality test are protectable. In other words, simple compilations of data are in the public domain.

This is what the U.S. Supreme Court decided in a case (Feist Publication Inc. v. Rural Telephone Services, III S Ct 1282, 1991) where it considered whether an alphabetical arrangement of telephone subscribers' names and numbers was copyrightable. The Court held that information consisting solely of facts arranged in a straightforward manner do not constitute "original works of authorship" within the meaning of the Copyright Act.

[12] The SCPA was described, for that reason, as "a solution in search of a problem" (Siegel and

This decision was viewed by some authors as "endangering the vitality of our information industries. To a nation that counts information as an important asset and a principal export, the outcome is (or should be) extremely worrisome" (Dreyfuss 1993: 197).

Europe shared this concern. The European Council Directive 96/9/EC, developed a new, *sui generis*, form of protection for any database if it is shown that qualitatively and/or quantitatively a "substantial investment in either obtaining, verification, or presentation of the contents" has been made (article 7).

The EC Directive provides for an "extraction right", i.e., the right to prevent "the extraction or re-utilisation of the whole or substantial part, evaluated quantitatively or qualitatively, of the contents of the database" (article 7).

This Directive provides a conspicuous example of the emerging paradigm of IPRs protection, wherein the main goal is not to protect creativity and ingenuity, but investments. Databases are, in effect, protected under the *sui generis* right without requiring originality in the selection or arrangement of their contents. In accordance with the European Commission, the main feature of the Directive is:

"to create a new economic right to protect the substantial investment of [compilers] by a database marker. Considering the considerable investment of human, technical and financial resources necessary to create a database, and given that those databases can be copied at a much lower cost than that of their development, such legal change is important. Unauthorised access to a database and the extraction of its contents are thus acts which can have grave technical and economic consequences" (EC Commission 1995: 32).

The Directive's sections on the *sui generis* right define two categories of restricted acts: extraction and re-utilisation. The right applies to the whole or a substantial part of a database, which means that an insubstantial part is not protected. Protection lasts for 15 years, and that period may be renewed if there has been substantial new investment. The Directive defines exceptions to the right which are similar to those existing in the chapter on copyright, but, in view of the volume of information in such databases, the exceptions are generally limited to the right of extraction. The *sui generis* right is conferred in addition to the other existing rights.

Laurie 1989: 14).

The Directive does not prescribe, but only authorise, Member countries to provide exceptions for the cases of extraction for "private purposes", "teaching or scientific research", "public security or an administration or judicial procedure" (article 9). Moreover, Member countries may limit the exception relating to teaching and research to "certain categories of teaching and scientific research institution" (Preamble, No. 52).

The "information industry" has welcomed the Directive, while questioning the U.S. Supreme Court attempt to keep information products in the public domain. The Diplomatic Conference convened by WIPO to develop a Protocol to the Berne Convention in December 1996 may, however, declare the European approach as the universal standard. One of the basic proposals to be considered by the Conference aims at establishing a treaty for the protection of non-original databases whose production entailed a "substantial investment".[13]

2.4.2 The "Information Superhighway"

The digitisation of information and the development of computer networks, such as Internet, are posing a new and far-reaching challenge to copyright. The way in which this challenge is finally resolved may have important implications with regard to access to information.

The main technological change behind this "new revolution" (G-7 Ministerial Conference 1995) are improvements in data storage, manipulation, and transmission. With digitisation, all kinds of data and copyright works may be recorded and compressed in the same binary, format. While this allows one to reproduce copies without any degradation (every copy is perfect), developments in software permit us to manipulate data, images, etc., make "sampling", and otherwise alter works by interactive techniques (Pearson 1996).

Data transmission, on the other hand, is no longer limited to a one-to-one basis, but now extends on a one-to-many or even one-to-all basis. A large computer network, such as Internet, thus becomes a "broadcasting" system. The growth of the system and the improvement of transmission techniques challenges the market position of several industries and services, including those related to voice transmission (Rowley 1995), radio broadcasting and

[13] See document WIPO CRNR/DC/6, 30.8.96.

phonograms[14], and the publishing of literary works (Heker 1995)[15] as well as of computer programs.

These developments have polarised opinions on the ways in which copyright law, should react in order to protect the producers and suppliers of different forms of information.

Adapting copyright. On the one hand, many authors and industrial groups consider that copyright only requires minor changes in order to adapt to the new technological changes (Holleyman and Steinhardt 1995: 56), particularly with respect to the scope of exploitation rights and the extent of the "fair use" exception, as conceived under Anglo-American law (Dreier 1993: 489; Dessemontet 1996: 287). This is the position held by the U.S. government in its "White Paper on Intellectual Property and the National Information Infrastructure".

According to that paper, "no more than minor clarification and limited amendment" of the Copyright Act is necessary (IITF 1995: 17). The proposed changes would strengthen the rights of the copyright owner, particularly by "transmission" and "publication". The only major change that would be necessary is the introduction of a *sui generis* right to supplement copyright protection for databases (Lehman 1995: 80).

Thus, the concepts of distribution, publication, and transmission would be dematerialised in order to make clear that exclusive rights can be exercised with respect to the communication of works in a digital form, and not only in the form of tangible copies.

The Diplomatic Conference to establish a possible Protocol to the Berne Convention will consider a proposal by the European Union unambiguously extending the right of communication to "any communication to the public including the making available of their works, by wire or wireless means, in such a way that members of the public may access these

[14] Phonogram producers, which are generally granted an exclusive right of distribution of material copies, and only a right to remuneration with regard to sound broadcasts, call now for an "exclusive broadcasting" right (Dreier 1993).
[15] Individual authors have in fact the unprecedented opportunity of becoming their own publishers and distributing their works in digital form through computer networks (Dixon and Self 1994: 466)

works from a place and a time individually chosen by them" (WIPO, BCP/CE/VII/1-INR/CE/VI/1, 20.5.96).

It should be noted that, according to some domestic legislation and case law, fixation, including "reproduction" of a work, exists when any data or programs are temporarily copies in the computer RAM (Dessemontet 1996; Dixon and Self 1994)[16]. Any unauthorised "copying" of any data or program constitutes, hence, an infringement.

This is also likely to be clarified in a Protocol to the Berne Convention. In accordance with a proposal to the European Community, "permanent or temporary storage of a protected work in any electronic medium constitutes a reproduction. This includes acts such as uploading and downloading of a work to or from the memory of a computer".

The narrowing of the "first-sale" exhaustion doctrine[17] has been also suggested, in order to avoid re-transmissions without the authorisation of the right holder; and there are also proposals to eliminate the "private use" exception (Holleyman and Steinhardt 1995: 65) and to consider that a "private copy" is no longer, in an electronic age, an "honest use" (Antequera Parrilli 1995: 187).

The "fair use" doctrine, it is argued, is justified when the transaction costs are too high and prevent copyright owners and users from entering into a copyright license, as in the case of library photocopying or home videotaping. But technologies exist today that enable copyright owners and users to negotiate individual licenses for electronically stored works at a low cost. This may be done, for instance, through a "Copyright Clearance Centre" that collects and administers royalties for each individual use (Goldstein 1994: 127, 223, 240).

The problem, according to the EC Commission, is that the criterion of strictly private use is becoming more fluid and difficult to apply. Digital technology could make home copying into a fully-fledged form of exploitation. A work can be reproduced systematically and any number of times without loss of quality. The danger of piracy and improper use without payment to the

[16] A work may be deemed "fixed" even if it only temporarily resides on the RAM computer linked to a network. This includes electronic transmissions such as e-mail (IITF 1995:.28).
[17] According to this doctrine, the rights of the title-holder with respect to a protected product are exhausted after the first sale thereof.

rightholders will increase. There may be a growing need for arrangements at a community level to remunerate rightholders, and for the progressive introduction of techniques to limit copying of this kind (EC Commission 1995: 28)

Based on its analysis, the EC Commission argues that while it was necessary to permit "private copying" when there were no means to prevent it, such copying is no longer justified since such means already exist (EC Commission 1995: 50, 52).

Reconceptualising copyright. On the other hand, some authors consider that copyright, created in order to respond to the problems posed by printing, and adapted later to audio-visual works, needs to be reconceptualised in the digital era. The copyright subject-matter has evolved over time from symbolic representations of sensual matter to the sensual matter itself, and from works passively received by the audience to works which interactively engage the audience. (Christie 1995: 523)

According to some views, the "right to prevent copying" (as conferred under copyright) should be replaced by a "right to prevent access" to a work (Olswang 1995). This, of course, would imply the power to prevent use, in open contradiction with the still-in-force basic idea/expression dichotomy. Exclusive rights granted by copyright, which are becoming "outdated and irrelevant", could be also replaced by mere rights to obtain a remuneration (Ricketson 1995: 898).

Others more drastically question the need for property rights at all, since on-line access to subject-matter may be allowed only to those who agree to pay for it and comply with various restrictions regarding use of it. Payment for access could be guaranteed by way of automatic, on-line, debiting of a credit card account or a bank deposit account. Developments in the technology should make it possible to "lock" the digital data constituting the subject-matter to which access is allowed, so as to prevent authorised use of it. In addition, it should be possible to detect and trace any subsequent unauthorised uses of the access subject-matter, and to automatically debit an account by way of a contractually agreed right to compensation for the unauthorised use (Christie 1995: 526).

3. IMPLICATIONS FOR DEVELOPING COUNTRIES

3.1 Access, Acquisition, and Use

The implications of the technological and legal trends described above on developing countries are felt in a multiplicity of areas and forms. They may affect both innovation and diffusion of ITs by potential users.

Diffusion of ITs is dependent upon three main conditions:

- **The access that potential users may have to certain hardware, software, and digital information.** Access may be limited by the lack of information on available options, commercial and governmental practices (e.g., restrictions on exports of technology due to security reasons), and legal impediments, such as those eventually stemming from IPRs.
- **The acquisition of the necessary hardware/software.** The acquisition of ITs is influenced by a number of factors, both internal and external. Internal factors refer to "who you are", "what you have done" in the past, and "what you want to be" (e.g., a firm's characteristics, past experience, and pursued strategies), while external factors refer to conditions which exist in the external environment and which may affect the adoption of decisions on technology acquisition and use (Lefebvre and Lefebvre 1995: 37, 39).

Table 2 summarises different external factors that may influence adoption of ITs by firms. IPRs are one of the multiple factors that, as a part of "national policies", may affect adoption of ITs. The relative weight of IPRs *vis-à-vis* other relevant factors is unknown, though by its very nature (the fact that it confers the right to exclude competitors) may in some cases have definite and strong influence on adoption.

- **The development of the capacity to efficiently use ITs.** The efficient use of ITs is dependent, on the one hand, on general education, and particularly on the way in which it influences "readiness" or willingness" to use ITs and to obtain access to digitised information[18].

[18] Based on the conclusions of Working Group 1, Information Technology (I.T.) and Development, United Nations Commission on Science and Technology for Development (UNCSTD), Cartagena, January 30 - February 2, 1996.

3.2 Impact of IPRs

The impact of IPRs on the access, acquisition, and use of ITs has not been systematically explored so far. Examining the impact of IPRs on access, acquisition, and use of ITs (and digital information) in developing countries is a difficult theoretical and empirical endeavour.

First, as mentioned above, it is extremely difficult to isolate the impact of legal factors from other social and economic considerations. There is no solid theoretical corpus to deal, in particular, with the impact of IPRs.

Second, ITs and the legal framework of IPRs are rapidly changing, and their likely impact in many areas is still uncertain.

Table 3 External Factors in the Adoption of ITs

Industry Characteristics	**Macroeconomic Environment**	**National Policies**
* *Overall competition* -type of competitors -number of competitors -proximity of competitors **Characteristics of demand* -type of customers -number of customers -sophistication of demand -requirements imposed by major customers **Degree of diffusion of technologies* -by technology -by type of competitor **Availability of external know-how* -agencies -institutes -technology suppliers/vendors -trade associations	*availability of capital *availability of qualified manpower *quality of industrial relations ***i**nflation *business cycle	*trade policies *IPRs policies *industry regulation *government buying practices *technology adoption tax credits *manpower training policies and programs

Source: adapted from (Lefebvre and Lefebvre 1995).

Third, major differences exist in the level of current diffusion and use of ITs among developing countries, in their capabilities to incorporate ITs, and in the level of protection of IPRs.[19]

Fourth, there is little empirical evidence on the conditions that affect the adoption of ITs in developing countries, and even less on IPRs-related factors.

Despite these limitations but without ignoring them the next section describes some of the possible implications of IPRs on IT adoption and use in developing countries.

3.3 Software

3.3.1 Production

Developing countries have a marginal role in the production of computer software. The capacity to produce packaged software is one the most important indicators on the degree of development of the software industry in a particular country. Table 3 indicates world distribution of packaged software production, consumption, and trade.

Table 3 Packaged Software: Production, Consumption, and Trade, 1991 (US$ billions)

	Production	%	Exports	%	Imports	%	Consumption	%
U.S.	39.98	78.3	20.04	93.1	0.61	2.8	20.54	40.2
Europe	8.24	16.1	0.86	4.0	13.77	28.4	21.16	41.5
Japan	2.21	4.3	0.12	0.6	3.32	15.4	5.41	10.6
Rest of World	0.62	1.2	0.49	2.3	3.81	17.7	3.94	7.7

Source: (Göransson 1994).

Table 3 shows that despite the progress made by some countries, such as India,[20] developing countries (as part of the "Rest of World") account for little more than 1% of total software production.

[19] This will become more harmonized once the transitional periods provided for by the TRIPs Agreement have expired, provided that the necessary changes to comply with said Agreement have been made at the national level.

[20] A significant proportion of Indian software exports is, however, only "body shopping"; see (Correa 1996).

Impact of patents. Patents confer stronger rights than copyrights. They permit holders to obtain monopoly rents by excluding competitors, totally or partially. If software patents are granted, several effects may be expected.

First, a patented program cannot be used as a basis for further development without the authorisation of the patent holder. This may block a whole area of possible innovation. Unlike chemical patents, it may be difficult in some cases to "invent around" software patents, since mathematical rules are logical and precise, and in some cases there may be no alternative way for obtaining the same effect.

Second, if a license is sought for and obtained on a piece of software, royalties may be too high particularly for a small firm to ensure the feasibility of the project. Access, hence, will be problematic.

Third, even if patents may be "by-passed" and new technical solutions found, serious problems still remain. It may be impossible to design a program that at a certain point will not infringe an existing patent. Patent searches to establish whether patents would be infringed are extremely costly and difficult to make. What is even worse, a patent search does not guarantee that a patent would not be infringed; if this is the case, litigation costs may force a small firm out of business (Warshofsky 1994: 168).

As a result, intimidated firms may opt for cancelling development projects. In a paper attributed to Bill Gates that highlights the monopolistic power conferred by patents in this area, it is stated that

While this approach will allow companies like Microsoft, Apple, and IBM to continue in business, it will shut new companies out of the field. A future start-up with no patents of its own will be forced to pay whatever price the giants choose to impose. That price might be high: established companies have an interest in excluding future competitors (quoted in Warshofsky 1994: 171).

It should be noted that the patenting of software is not an obligation under the TRIPs Agreement. The Agreement does not include a definition of "invention"; therefore, any Member country may consider that computer programs as such are not patentable. This would not

prevent, however, the granting of software-related patents, for instance, for hardware systems that are operated by an inventive software.

Impact of copyright. Trends relating to copyright may have a significant impact on the production of software, including multimedia products, in developing countries. The impact on production will be dependent on the modalities of protection, particularly on the degree to which the idea/expression dichotomy is recognised and enforced, and the extent to which "look and feel" is deemed proprietary by domestic law.

The existence of protection against literal copying of software as required by the TRIPs Agreement clearly benefits all interested in the marketing of computer programs, whether local or foreign producers. However, the main beneficiaries are those that sell packaged software, since illegal reproduction of custom software may be prevented, even more efficiently, by means of contractual stipulations. Developing countries have made, as indicated above, little progress in the production of packaged software so far.

If legitimate reverse engineering is limited, potential producers will have to pay royalties for the use of existing programs, or remain outside the market. Allowing for reverse engineering will not, however, solve all problems. As mentioned above, it doesn't work with large programs. In addition, decompilation and disassembly are complex, time-consuming, and laborious tasks. The process requires considerable skills, and while executing it the programmers must supply information not available in the computer-executable program. If the purpose of the process is to obtain a "clone" program, once the programmer has completed the analysis and determined the detailed specifications, he has to initiate the software engineering development in order to transform the specifications into new source code (Correa 1993).

For these reasons, decompilation and disassembly are not used routinely. The Office of Technology Assessment did not find evidence indicating that decompilation is widely used by "pirates" to decompile entire programs and then rearrange the code in an attempt to hide copying (OTA 1992: 148).

On the other hand, access to user interfaces ("look and feel"), though also requiring skills and effort, makes possible the development of competitive products. It is extremely difficult for software start-ups to compete with companies selling established products if access to such

interfaces is restricted. Users are not interested in new products for which they must learn a new set of commands.

There are no internationally accepted rules on the extent of protection of user interfaces. Even in the United States, despite the decision in Lotus v. Paperback (which recognised protection on menu command structures), other cases have been solved in a more cautious and restrictive way.

In the case of multimedia products, the re-use of existing copyrighted materials from numerous right-holders may pose great burdens and high transaction costs. The viability of a multimedia industry may be dependent upon a system of royalty collection, based on a remuneration right or compulsory licenses.

Compulsory licenses allow the use of a protected work without the consent of the title-holder. They are common in patent as well as in copyright law. In the United States, for instance, once a song is recorded with the author's consent, anyone can record his/her own version, just by paying a fixed royalty (6.25 cents) (Goldstein 1994: 20). The Appendix to the Berne Convention (1971) provides for compulsory licenses for developing countries, which so far have been only rarely used.

As indicated above, the TRIPs Agreement does incorporate the idea/expression dichotomy (article 9.2). National legislation can, therefore, legitimately provide for reverse engineering of computer programs, to develop either interoperative or substitute programs. It may also deny protection to input and output formats (user interfaces). Compulsory licenses may be implemented under said Agreement, in accordance with the Appendix to the Berne Convention (1971).

Developing countries may, however, be under pressure not to recognise the right to evaluate and reverse-engineer. In South Korea, though an explicit "fair use" exception in this regard was considered during the process of revision of the Computer Program Protection Act, the finally approved reform eliminated such an exception (*World Intellectual Property Report* (1995), 9, 349).

3.3.2 Use

Strict enforcement of IPRs may negatively affect the diffusion of computer programs. If, as generally assumed, such a diffusion may foster increases in productivity and enhance firms' competitiveness, barriers to diffusion may in turn jeopardise economic performance.

Liberal copying would arguably reduce the cost of access to software. In the last analysis, one observer suggests that for a country which is not an innovator, it may be convenient, from an economic perspective, to facilitate the obtaining of copies at low cost to stimulate a rapid software diffusion and save foreign currency (Wells 1987).

However, the advantages of unrestricted dissemination of non-authorised copies may be offset by some disadvantages (Correa 1990c). First, the lack of appropriate maintenance and after-sales support may hamper an efficient use of computer programs. Second, weak copyright protection may slow the diffusion of certain types of high-quality or complex software. Third, all WTO Member countries will be obliged (by 2000 in the case of developing countries) to provide protection of computer programs as "literary works", in accordance to the TRIPs Agreement. Non-complying countries may be subject to trade retaliations.

On the other hand, the effect of unlimited or widespread copying on society's economic welfare is ambiguous. It depends upon a number of factors, including relative costs (of producing a copy versus another "original"), the degree to which copying affects the demand for originals, the production of new works, and the degree to which consumers value additional variety. Thus, copying may increase consumer welfare and producer profits in the short run if private copying is efficient and the price of originals can be raised (OTA 1992: 200).

Increases in prices may be required by producers in order to recover, from paying users, income loss caused by copying. Suppliers may deliberately discriminate prices in accordance with income levels of different countries or user groups, charging some of them prices higher than the marginal cost (Gates 1995: 266).

Copying may, however, cause producers to reduce prices in order to encourage the acquisition of legal copies. It may also reduce the number of originals produced and thereby "excessive" variety. This can increase welfare in the long run (OTA 1992: 200).

3.4 Hardware

The impact of current IPRs trends on access to technology for the production of hardware in developing countries, may also be significant. The Washington Treaty, as supplemented by the TRIPs Agreement, may have significant implications for new potential entrants and for the diffusion of microelectronics technology on a world scale.

The highly concentrated structure of the industry and the growing reluctance of major firms to transfer their technology suggest that access to semiconductor technology is and will continue to be extremely difficult. Protection is not likely to favour either innovation or technology transfer to developing countries, but rather to reinforce the tendency of innovative firms not to part with their technology (Correa 1990b).

Developing countries and, in particular, NICs are likely to be the most affected by the new regulations. Such countries are basically importers of integrated circuits and of informatics products. They will be at a great disadvantage to determine whether chips imported or incorporated into imported products are infringing or not, especially if as determined by the TRIPs Agreement custom authorities are empowered to adopt measures at the border.

Title-holders are authorised, under the TRIPs Agreement, to stop the importation of industrial articles if they include an infringing chip (independent of its relevance both in terms of cost and function in the product). Trade flows may thus be significantly distorted. In addition, even an innocent infringer can be obliged to pay a compensation to the design title-holder, or be forced to stop production or distribution.

Though the *sui generis* regime on integrated circuit designs allows reverse engineering of protected layout designs, very few countries have the resources and skills necessary to undertake it. The process is extremely complex and costly, and even if successfully undertaken, the production and marketing of chips presents, as mentioned, formidable entry barriers.

In addition, patent protection in this area is very extensive. It is covered by literally thousands of patents, and it is not possible, therefore, to license technology from a single firm. Moreover, a

few large firms control substantial blocks of patents, and hence exercise considerable power over the terms on which technology is available (Mody 1989: 38)[21]

The impact of IPRs, finally, may also extend from software to hardware. While PC producers were able to develop quite successfully indeed IBM "clones" on the basis of reverse engineering the PC's "BIOS" (Basic Input-Output-System)[22], attempts have been made to foreclose that possibility. Thus, IBM increased royalty rates (from 1% to 5%) on IBM's AT machines, demanded retroactive payments, and tried to prevent cloning of its PS/2 series of microcomputers by restricting access to the micro channel architecture (Mody 1989: 36).

3.5 Information

Developments with respect to the protection of databases under a *sui generis* right against "extraction" will extend coverage of the appropriation of information well beyond the limits of copyright law. The impact of this expansion is difficult to predict. As mentioned before, it may become an international rule if approved by the Diplomatic Conference on a Protocol to the Berne Convention.

Like other IT industries, the "information industry" is largely controlled by firms in industrialised countries. Some developing countries have provided low-cost labour to "input" data, but they generally lack the organisation and resources to distribute databases. On the other side, technological advances with CD-ROMs, which permit the distribution of copies of databases, is changing the "on-line" model of supply by a mix of digital and material carriers. A paradoxical implication of the new technological developments is that while they facilitate "almost unfettered access to protected works" (Dreier 1993: 488) and the easy, rapid, and inexpensive making of "perfect" copies, it also offers the technical means to control and manage such access.

Thus, devices can be implemented to allow access but not the copying of a work (Quintanilla Madero 1995: 43). Transmission is made by "pieces" and it is possible to prevent the full

[21] According to Texas Instruments, for instance, "it is pretty impossible to make DRAM chips without using one of our patents" (Financial Times, 23 November 1988, 26; quoted by Mody 1989: 39).

[22] Which is protected by copyright, and hence, susceptible of being legally accessed and reverse engineered.

recomposition of the work. Already CD-ROMs can be encrypted, and many encryption and license management technologies are under development or in use to prevent copying. For instance, within the EC ESPRIT II Program, a system of this type (see Box 4) was developed.

Databases and other suppliers of digitised information have established terms and conditions for the transfer of information that restrict both access and use of data. They condition access upon the payment of different fees (subscription, search-time, down-loading, etc.) and are able to control and charge for each and every access and use by the user of electronically processed information (who must log in and out). This control nullifies in practice the users' right normally granted under copyright to make copies for personal uses or for research purposes [23](Reichman 1993).

Box 4
Copyright in Transmitted Electronic Documents (CITED)

The model that the pan-European team has come up with is built around a tamper-proof software module which acts rather like indestructible tachometers installed on long-distance coaches and lorries, recording everything that happens to the copyrighted or commercially valuable material. The basic idea is that the valuable material is linked to a specific piece of software. This software is required to gain access to the material, and it can only be converted into its usable form by someone in possession of the right key or password.

Thus, when the authorised user requests a piece of software or some pages of a report or journal, he or she will have to key in a password. From then on, each time a program is run or a print of a page is made, the associated software module sends a message back to the secure database stored on the computer. The database can then track every activity carried out by the organisation's software modules, thus providing an audit trail which shows whether materials are being printed or copied electronically. Eventually, it may possible to forward this information to rights societies to help them determine how much artists, authors, and publishers should be paid.

Source: Lawrence, A., *New Society*, February 1995.

Many institutional users of digital information (such as libraries) have already complained about the difficulty of managing and complying with the variety of contract terms required by their large collections of data and software packages. Moreover, "because of uncertainties about users rights to download or make copies of information, providers of digital information rely on contract to limit customers' uses of information and do not sell information to customers, but

[23] Other restrictions include, for instance, "one-at-a-time" use requirements that forbid networking by multiple users.

merely authorise certain uses" (OTA 1992: 26).[24] According to Reichman, "aggressive licensing of electronic information tools could thus distort the public service mission of libraries by making them involuntary collection agents for publishers" (Reichman 1993: 464).

Libraries, as document suppliers, are regarded as direct competitors of database providers and other commercial services. Libraries can not only receive and store information, but repackage and electronically distribute it to an indefinite number of users.

Technical and legal developments, if combined, may result in growing barriers to the access to all types of information, which will be increasingly channelled through digital networks. Such barriers are likely to affect not only technology, but also general factual information, as well as scientific knowledge. This may consolidate existing trends not to openly diffuse the results of scientific research (Correa 1994b), thereby restricting access to the pool of science by developing countries.

[24] In some cases, data providers require librarians to waive contractually the privileges that copyright law otherwise afford (Reichman, 1993).

4. CONCLUSIONS

The following main conclusions may be drawn from the study made:

- Important changes in the paradigm of IPRs regulation are taking place. The emphasis has shifted from the protection of the author/inventor to that of the investor, as epitomised by the recent EC Directive on databases. Moreover, new proposals are on the table to further expand appropriation so as to cover factual materials as such, i.e., non-copyrightable information.

- A process of universalisation of IPRs standards of protection, has been fostered by the Uruguay Round. The TRIPs Agreement has clarified and reinforced IPRs protection in three key IT areas: computer programs, databases, and layout designs of integrated circuits. The Agreement leaves, however, certain room to implement its standards in accordance with national legal systems and interests.

- The characteristics of software technology explain the key role played by IPRs in this field. Computer programs may be developed on the basis of knowledge in the public domain, and hence challenges to established firms may arise, in principle, at any place and time. Though market barriers are sufficiently high to reduce that opportunity for newcomers, major software producers have actively sought for expanding and increasing protection. The easy and inexpensive production of "pirate" copies is another reason behind that interest in IPRs.

- Trends with respect to the protection of computer programs show hesitation, conflict, and the inadequacies of copyright law to protect functional works. Despite some case law that extended copyright protection well beyond expression, the idea/expression dichotomy explicitly incorporated by the TRIPs Agreement limits the extent of exclusive rights and allows for (legitimate) reverse engineering. Countries are also free to decide about the scope and extent of protection of user interfaces.

- Given the essentially incremental nature of innovation in software, access to existing programs is crucial to keep a healthy environment for innovation and competition. Access to underlying ideas and concepts may be seriously restricted, however, by the patenting of computer programs. Patenting may lead to complete exclusion from certain market segments, and threatens eventual competitors with costly litigation that may discourage firms or force them out of business.

- Current trends on IPRs relating to computer programs may impose even harder conditions for the development of a software industry in developing countries. This will depend, however, on the way in which such countries frame their domestic laws while abiding by the TRIPs Agreement. It should be noted, in particular, that there is no obligation under existing international standards to confer patent protection on computer software.

- Barriers to participation in the semiconductor industry are very high. The *sui generis* protection of the layout design of integrated circuits does not add too much to the fortress that the few chips producers have been able to build up. Unlike the case of computer programs, such producers can survive and make progress (as happened in the past) without such a protection. Patents on key semiconductor technologies permit the erection of even higher barriers for potential new entrants.

- Strict enforcement of anti-piracy laws in the software area may lead to high prices and limit access by individuals and small firms. Such enforcement, however, is an unavoidable feature of current IPRs regime. While in developing countries it mainly benefits (foreign) producers of packaged software, it can also help local industry to avoid illegal duplication and unfair competition. It may also open opportunities in some instances to develop programs less expensive and better adapted to local conditions than imported packages.

- Finally, with the development of computer networks and the possibility of providing a digital format to any piece of information, a major challenge has arisen. Technological and legal changes (such as the elimination of the exception for private copying or "fair use") may dramatically increase barriers for the access to and use of information of any kind, copyrightable or not. While cyberspace is opening up enormous possibilities for low-cost communication on a world scale, legal developments may close the prospects of an information society with equality of opportunities and free circulation of ideas and information.

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