PROACTION AND PARTICIPATION: EVOLVING MODES OF STANDARD-SETTING FOR COMMUNICATIONS AND INFORMATION TECHNOLOGIES

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ABSTRACT

Over the past 10 - 15 years the fields of information and communication technology have been converging into a single entity concerned broadly with all forms of electronic message transfer. A key aspect of this emerging environment is the necessity for interconnectivity among its component parts irrespective of proprietary origin. Thus, the issue of standards adoption has become a crucial aspect of industrial planning in this area. The rapid pace at which these technologies develop along with their infrastructural role in the industrial fabric has led to the practice of setting standards proactively - that is, in anticipation of service applications.

The present study examines the relationship between the proactive mode of standards-setting and participatory models and rationales. The initial premise is that standards-setting is as much socially as technically determined. The analysis is thus predicated upon the outline of a bi-level theory of standards practice which aims to link broad motivational rationales and definitions with subject specific ones. Using documentary surveys, historical examples, and an extensive series of personal interviews with officials active in the international standards-setting arena, perceptions as to the nature of proaction and participation are detailed.

There are several primary conclusions. Firstly, "proactive standardization" is a real term in the discourse. Secondly, the term refers less to the relative maturity of the

technology than to the context of its application. Thirdly, proaction is a strategic device available to both users and suppliers of technical products and services, and it has the ultimate aim of actively directing conditions for the deployment of technologies.

With respect to participation, speculation that future emphasis will be on national representation to international fora, and that there will be an emergence of career standards professionals combining technical and business strategy functions is confirmed. New fora are identified which may impact upon the influence of established standards writing bodies and the consensus method of decision making they have traditionally embodied. The further possibility is raised that international fora may be relegated to approval functions.

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Special thanks is owing to Liora Salter, my senior supervisor, who placed sufficient confidence in me such that I was entrusted with carrying out a portion of research directed at the production of her forthcoming report on communications standards to Communications Canada. Without the opportunity this afforded to interview many highly placed individuals in several parts of the world, the scope of this study would have been much reduced. I am also in her debt for introducing me to this fascinating area of study, and for generously encouraging and guiding my efforts.

A word of thanks is also in order to my supervisory committee: To Bill Leiss for his consistent exhortations to clear thought, to Don George for having the patience to guide a non-engineer through the minefield of technical concepts and terminology, and to Peter Anderson for his encouragement and for being instrumental in helping to draw the initial connections from which this work emerged.

Special thanks is also owing to Don McLean of Communications Canada in Ottawa, who took an interest in the work and was instrumental in directing me towards many of his colleagues who in turn proved instrumental in guiding the initial stages of the research. Although the conditions attached to the interview portion of the research do not permit identification of the many people who gave freely of their time to answer my many questions, I wish nonetheless to thank the officials and staff at the Standards Council of Canada, Canadian Standards Association,the British Standards Institution, the International Organization for Standardization, The International Electrotechnical Commission, the International Telecommunications Union, and the Commission of the European Communities, Directorate-General XIII.

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Chapter 1

Introduction

With respect to the development of technical standards, it has only been in the last decade that the common interests of the communications and information processing industries have reached the level of open and sustained debate. Historically, very different rationales for standardization have operated in each sector. Moreover, there have been traditionally enforced lines of demarcation between information production and its transmission. By regulation, most telecommunications carriers may not generally produce the information they carry, nor are they permitted to alter the content of messages. Concerns over radio spectrum use and information security have likewise mandated strict measures to separate data flows from general broadcast messages. Other such examples are abundant.

The logic of this situation, however, has become the subject of often heated discussion in recent years. The term "convergence" - indicating the elimination of heretofore accepted distinctions between information production and transmission - has become something of a password in the evolving concept of an information economy. The vehicle which has suggested the elimination of these distinctions most strongly is digital technology - a development which has been applied with equivalent degrees of success to both the information and the communication technology areas. Wedded to this technology is an applications environment which has only recently become competitive (albeit in varying degrees) resulting in an unprecedented proliferation of technical products and services in an often heated marketplace.

The discussion in the pages to follow will take this phenomenon of convergence as a cue, and will focus upon the emergence of standards-setting during the past 10-15 years as a central factor in the development, marketing, and application of information and communication systems. The key areas of concern will be the nature of participation in the standards-setting process, and the modes of practice by which standards are set.

With regard to the latter concern, the specific prospect of "proactive" standards will be examined. The virtually unprecedented speed with which communications and information technologies (referred to hereafter as CIT) have been developing has led to a reappraisal of traditional modes of standardization practice which were predominantly reactive in nature and which required long periods of time. In the broadest sense, "proactive" has come to be regarded as the practice of setting standards in anticipation of systems needs.

Participation in the standards-setting process is governed to a large extent by the mode of practice. The commonly accepted approach to developing standards which will take into account the interests of all interested parties, and therefore be most assured of ultimate acceptance in the marketplace, is to develop standards by consensus among a group of volunteers representing those various interests. When dealing with known quantities - technologies which already have wide applications and for which a definite market structure has emerged - this practice has proven very adequate. For rapidly developing and changing technologies in volatile markets, however, the consensus pattern of participation displays some unique wrinkles regardless of whether the mode of operation is reactive or proactive. It will be argued, however, that the term "proactive" is in practice a term of convenience for a profound alteration in the general practice of setting industrial standards. As such, the implications for participation in standardization are potentially acute.

Ultimately, it is the task of the present work to examine the relationship of participation and proaction as variables in the standardization process. What are the characteristics of a "proactive" mode of standards-setting, and, as demonstrated by recent experiences in the communications and information technology sector, does this practice restrict or enhance the possibilities for participation in consensus standardization practices? This is the central question which will inform and organize the observations and conclusions which follow.

Survey and Evaluation of Research Resources

In both the technical and the social science literature, the general subject of standards is a sparsely covered area.

It is one of the seeming paradoxes of the field, that although standards are set in some of the most open existing forums for technical discourse, both the activity and its applications tend to remain invisible. To a large extent this is a tribute to the effectiveness of the standardization process which has evolved over the past century or more. Good standards eliminate common problems and it is the problems, not the already applied solutions, which generally command attention.

The realm of standards has long stood suspended and ignored between the poles of technical and social response - much as the mushroom is said to exist in a "third kingdom" somewhere between animal and vegetable. Thus, for example, although the potential effects of standards in the marketplace have been obvious enough for a very long time, economic studies of the practice have been rare until very recently, and the body of economic theory is yet in its nascent stages. Likewise, the technical community has largely regarded standards preparation as something to be done, but not necessarily as something to be considered as a separate discipline or sub-discipline of the technical professions. A social science perspective on the field is virtually lacking save for a handful of tantalizing writings.

Indeed, standards constitute a lacuna in the study of industrial societies. Secondary and tertiary documentation exists in such small quantities that it is a relatively quick task to assemble and assimilate this material. In contrast, the primary documents present the researcher with an enormous body of material. Standard-setting is a highly bureaucratic process accomplished amidst a plethora of formal questions, operating procedures, terms of reference, technical proposals, ballots, comments, and minutes of meetings. The finished standards themselves exist in the tens of thousands and encompass every conceivable area of technology at national, regional and international levels.

Assessment of the primary material is made yet more difficult in that it is almost entirely framed in detailed technical discourse, often mandating consultation with the actual standards-writers to enable decipherment. The research task was facilitated somewhat in that English has become the quasi-official *lingua franca* of international standards - a significant development in itself, as will be shown.

There are a few highly significant treatments of the broad subject area. Lal C. Verman's ground-breaking work *Standardization: A New Discipline*, published in 1973, is the first major attempt to codify and contextualize the activity of standardization and to place it in a broader framework than that of purely an engineering activity.(1) In 1979, Rhonda Crane drew attention to the wider geo-political implications of the standards process in her exposition of the first European attempts to adopt a universal standard for colour television transmission.(2) By way of preparing a report to

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1. Lal C. Verman, *Standardization: A New Discipline* (Hamden: Archon Books, 1973). Verman was a distinguished Indian physicist, and a long-time Director General of the Indian Standardization Institution.

the US Dept. of Commerce concerning the implications of the computer and telecommunication standards efforts which had been instigated in the late 1970s by various international standards organizations, Dorothy Cerni produced a highly significant background study of the standardization rationale. Her work expands upon the argument put forth by Verman that standardization should be regarded as an activity with an independent nature, capable of alliance with a great range of human activity beyond the purely technical. The origin of the present work owes much to Cerni's prescient analysis.(3)

Cerni's work has also been the background to a significant new book by Carl Cargill, a volume which may well assume the position of "basic text" in the CIT standardization area.(4) The concept of the use of standards as a strategic implement in the development and marketing of new CIT technologies finds its clearest expression to date in Cargill's work.

In 1975, the way was prepared for the current interest in economic analysis of standardization with the publication of David Hemenway's book *Industrywide Voluntary Product Standards*.(5) The preliminary analytical taxonomy of

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2. Rhonda Crane, *The Politics of International Standards: France and the Color TV War* (Norwood: Ablex, 1979).

3. D. M. Cerni, *Standards in Process: Foundations and Profiles of ISDN and OSI Studies* (Washington: US Dept. of Commerce, December 1984).

4. Carl F. Cargill, *Information Technology Standardization: Theory, Process, and Organizations* (Maynard Mass.: Digital Press, 1989). Cargill is the standards theorist for Digital Equipment Corporation.

5. David Hemenway, *Industrywide Voluntary Product Standards* (Cambridge, Mass.: Ballinger, 1975.

standardization was in many respects established by this work. The bulk of the economics literature in this subject area has been produced in the present decade and is significant. This is particularly true as it has been economists who have assembled by far the largest inventory of case studies.

A less well known but highly thorough exposition of traditional modes of thought and practice for standards-setting is that by Robert Legget, published in 1970 to coincide with the creation of the Standards Council of Canada.(6) Finally, the whole matter of the social construction of standards has been dealt with at some length in a pioneering study by Liora Salter dealing with the standards-setting process for the management of hazardous chemicals.(7)

With the exception of Cerni and Cargill, the works just cited do not deal with standards for CIT. In fact, Legget, Verman, Hemenway, and to an extent, even Crane, were writing at a time before standardization had become a real issue in this field. By far the most fecund sources of documentation specific to CIT standardization are the various reports, conference proceedings, and internal memoranda prepared for governments, international organizations, industry, user groups, and standards developing bodies. In particular, the

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6. Robert Legget, *Standards in Canada* (Ottawa: Information Canada, 1970).

7. Liora Salter, *Mandated Science: Science and Scientists in the Making of Standards* (Dordrecht: Kluwer Academic Publishers, 1988).

Organization for Economic Cooperation and Development has sustained several inquiries over the past five years.

Second in importance is the trade and technical press in the fields of telecommunications, data processing, computing, and in electronics engineering generally. Given the differing attitudes of various CIT industry and user sectors towards standards, it is particularly in the comparison of the trade press material emanating from these groups that elements of an overall CIT standards perspective can be clarified to any degree. As much diverse opinion exists within this sector, comparative analysis of the trade press can provide the backbone of an analytical, even critical, perspective.

Methodology

Preliminary investigation into the subject of standards for CIT revealed several obvious pitfalls. Chiefly these dangers concern allowing the research to become too broadly scattered into peripheral areas. For example, as computers now form an essential part of the telecommunications system, where does one draw the line in investigating computer technology? Does one include standards for items like operating systems and software development?

It was decided to limit the definition of what constitutes a particularly CIT standards issue by the isolation of a "keyword" which would help position individual standards and broad issues within a more manageable framework. The keyword decided upon is "interface." For purposes of this study, a CIT standard will be considered to be one which is developed for the broad purpose of allowing technologies of differing generations, internal specifications, proprietary manufacture, and national origin to connect to each other for the purpose of message transfer.

The second methodological problem was how to position the various kinds of documentary material in terms of its potential significance to the aims of the study. It was ascertained that the principle information to be gleaned from the sort of primary resources outlined above would be technical in nature and that beyond indicating the general flavour of the activity, its usefulness would be confined to providing technical details regarding particular standards. Consequently, it was decided to concentrate documentary research on the more general publications as elaborated above, and on the trade and technical literature.

Interviews form a central pillar in the methodology followed in this study. Given that one of the prime variables under scrutiny is "participation," it was imperative to fill a significant gap in the available literature and make a direct attempt to gain an idea of the perceptions, motivations, and practices of those directly involved in the standards-setting process as technical experts, strategists, and administrators. The possible scope of this part of the work was enlarged considerably when the writer had the good fortune to become a research associate for a Communications Canada funded project concerning CIT standards. It became possible thereby to interview a wide international spectrum of middle and senior level standards operatives in government, industry, and in the standards writing organizations.(8)

The discussion which follows will begin with an examination of the standard itself and will propose that a much broader definition of the activity is in order given the dynamics of the present industrial and corporate environment. In tandem with this, a broad theoretical framework will be suggested in order to locate the standards-setting process more securely within a social science perspective.

The distinctions between information technology and communications technology will next be explored so that the differing historical position of standards in each area as well as the present areas of conflict can be identified. This will enable an analysis of the various motives and rationales for participation in the CIT standards process.

The concept of "proaction" will be introduced by way of contrast to traditional modes of standards practice. In this endeavor, two historical examples will be used. The case of the development of the X.25 standards for packet switching interfaces into public networks is presented as an example of a transition in thinking between reactive and proactive practices. The NAPLPS Videotex standard is used to illustrate those attributes which could be considered in both theory and

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8. Interviews were undertaken under formal and rigorous conditions. Notes and transcripts were made, copies of which are in the writer's possession and are used in this work by permission of the Department of Communications contractor, for whom they were compiled. As anonymity was promised for purposes of the Communications Canada study, it has been preserved in the present work - interview subjects will be identified only by general information as to their positions and relevant activities.

practice to embody most elements of a truly proactive standard. These illustrations were compiled from the results of documentary research (including several existing case studies) and from personal interviews.

Finally, there will be an analysis of the issues underlying the "proactive standard," and of the implications of these for participation in the general standards-setting enterprise.

Throughout the course of the research, many features of the standardization process were noted which could well form the basis of an extended political economy of standardization. Several such instances will, no doubt, be detected by the reader in the following pages. Given the admitted infancy of standards studies from a social science perspective, however, the present work is not an attempt to construct a comprehensive political economy.

Rather, the purpose is to organize a portion of the background for a political economy of standards by outlining the salient features of the standards milieu as they attend to the specific areas of communications and information technologies, and then documenting how the standards requirements in this field appear to be affecting the established attitudes and mechanisms for standards development. The work is presented in the expectation that it may suggest appropriate hypotheses to form a basis for the kind of detailed research which will be necessary in order for a body of useful theory to emerge.

Chapter 2

The Idea of the Standard

Definitions of standards and standardization are invariably tied up with specific applications of the activity. Thus, in a discussion of standards of behavior, for example, a legal theorist might well adopt a different perspective to that of an anthropologist. The separation of terminology becomes even more pronounced whenever technical and industrial standards are compared with social standards in their many forms. This difficulty is reflective, moreover, of a general propensity to ignore or underplay the connectedness of the social and technical milieus.

This bifurcated attitude has long been entrenched and owes something to the disciplinary treatment of problem definition. Consider, for instance, the following words written in 1929 in which it is sought to explain the nature of the engineering "problem" as it could be applied to standards work.

> "As an engineer, one does not discuss the social sciences, draw codes of ethics, morality, or good conduct, discourse on aesthetic values or introduce legislative measures."(1)

It must be quickly affirmed that the authors of this sentence were by no means unaware of the broad social milieu within which standards function: the quotation is merely an admission of a central obstacle - that of the tendency of the engineer's

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1. National Industrial Conference Board Inc, *Industrial Standardization* (New York: National Industrial Conference Board Inc., 1929. p. 61.

definition of "problem" to isolate his or her standards related work from a more universal concept of the activity.

The writer would assert at the outset that such divisions are artificial, and based solely on perspective. They also serve to obscure the nature of the standard itself with the result that its forms and functions are often misunderstood in both technical and non-technical applications.

It is possible to write an entire exposition of standard-setting based on the merest sketch of a definition for the standard itself, relying instead on case-histories to explain and contextualize the activity. Reddy uses the definitional problematics of standards to theoretical advantage - suggesting that a proper definition is impossible using current economic perspectives on standardization which tend to concentrate on the production of standards and not on their use, and on elements of competition over cooperation.(2) Sullivan, on the other hand, is satisfied with the rather perfunctory definition that standards are "a category of documents whose function is to control some aspect of human behavior."(3) In this instance, unfortunately, cursory attention to definition leads to taxonomical imprecision.

The present writer considers it imperative to examine the derivations of commonly accepted definitions and

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2. Mohan Reddy, "The Role of Voluntary Product Standards in Industrial Markets," Unpublished dissertation, Case Western Reserve University, 1985, pp. 18-23.

3. Charles D. Sullivan, *Standards and Standardization: Basic Principles and Applications* (New York: M. Dekker Inc., 1983, p. 2.

classifications in standards practice and to comment on their use. In order for a critical perspective to emerge which will prove broad enough to permit observation of the proaction and participation variables identified above, it is necessary to clarify those aspects of standards and standardization which are common to most manifestations of the practice.

Problems with the Technically Framed Definition

Although Verman begins his explanation of the nature of standards with examples from natural and social history (evolution, language and the like), as well as from technological history, he nonetheless sees the ultimate outcome of this type of natural and human action as culminating in the activity we recognize as engineering.

Accordingly, Verman's treatment of standards and standardization is framed in terms of the engineer's craft and this leads him to a qualified acceptance of the definitions of "standardization" and "standard" as proposed by the International Organization for Standardization (ISO), the principal international body for industrial standards development. In this case, the logic of the definition of "standardization" begets a subsequent definition of the "standard." In order to avoid initial definitional confusion over these terms, it should be said that "standardization" is commonly accepted as indicating the actions or processes by which the "standard" is formulated and applied. Thus, most definitions can be easily framed in terms of either the nominal or the active function.

The ISO definition of standardization in question has essentially two parts. To begin:

> "*Standardization* is the process of formulating and applying rules for an orderly approach to a specific activity for the benefit and with the cooperation of all concerned, and in particular for the promotion of optimum overall economy taking due account of functional conditions and safety requirements."(4)

With the possible exception of the last requirement - optimum economy etc. - this part of the definition is not specific to purely technical standards. However, the second part of the definition is by way of such a qualification, even though it incorporates a final sentence which drifts off (incongruously) into imprecision.

> "It is based on the consolidated results of science, technique and experience. It determines not only the basis for the present but also for future development, and it should keep pace with progress."(5)

By substantially accepting this definition, Verman can be said to be in the mainstream of understanding as to what a standard is when seen from a purely technical perspective. By way of qualification, however, Verman quotes a more intriguing general definition as proposed by S. K. Sen.

> "*Standardization* is the process by which systems and values are established in individual, group and social life by natural evolution, custom, authority or common consent ... " (6)

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4. The Definition is from an ISO document dated 1971 and is quoted in Verman, p. 20. Legget uses this same ISO definition of "standardization," and the subsequent definition of "standard" as starting points for his discussion. (Legget, pp. 23-24).

5. Verman, p. 20.

6. The definition is from S. K. Sen, "Defining standardization," *ISI Bulletin*, vol. 23, 1971, quoted in Verman, p. 23.

Sen further asserts, however, that standardization has the characteristic of being "invariable over a period of time in a changing environment," thus contributing to various forms of social stability within a culture.(7) Sen's definition raises a substantial problem of function, and Verman elects to treat it cautiously, referring it to further study. Given Sen's premises, how exactly does a "standard" relate to, or differ from a "tradition?" Or, more broadly, how are the social and technical functions of the standard related? Verman is generally content only to suggest these dialogues, as are the majority of writers on standards.

In terms of the identification of actual processes and their various fora, the raw materials for discussion stem not from the ISO's definition of "standardization" but rather from its definition of the "standard."

> "A standard is the result of a particular standardization effort, approved by a recognized authority. It may take the form of: (1) a document ... (2) a fundamental unit or physical constant ... (3) an object for physical comparison."(8)

It is clear by this that there is expected to be an element of formal institutionalization involved, and that the "standard" will exist by way of reference to a physical item or document of some description.

Cerni offers a less specific but somewhat more functional definition, which also suggests a primary purpose for a standard.

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7. *Ibid.*

8. Verman, p. 23.

> "Standards generally describe, define, or document an already existing reality (or problem solution), thereby avoiding a duplication of effort."(9)

Kemmler adds yet a further dimension to the definition of standards, in that he specifically locates the activity in a consensual environment. Kemmler's resulting definition of the standard is the most succinct enunciation known to the present writer of the standards enterprise as seen from the engineer's perspective.

> "(a standard is) a technical specification or other document, available to the public, drawn up with the cooperation and consensus or general approval of all interests affected by it, based on the consolidated results of science, technology, and experience, aimed at the promotion of optimum community benefits, and approved by a body recognized in the national, regional, or international level."(10)

Missing from all of the above attempts at definition is adequate allowance for the question of how standards activity is *motivated*: At best, a system of rationales can be constructed out of them to explain the activity in terms of its perceived benefits. In order to progress any further in the search for a more comprehensive definition, however, the questions of what can be standardized, and how standards can be set must be addressed.

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9. Cerni (1984), p. 9.

10. The Definition is from E. L. Kemmler, "Codes, Standards, Accreditation, and Certification," *ASTM Standardization News*, Vol. 11, No. 6, 1983, quoted in Cerni (1984), p. 10.

Subjects, Aspects and Levels - The Physical Features of Standards

Using a tri-axial diagramme, Verman has illustrated the relationships involved in standardization in somewhat classic fashion (Figure 1) and his attribution of the agents involved as "subject", "aspect," and "level" is comprehensive.(11)

It may be said that any accoutrement of human life can become the subject of a standard provided there is sufficient impetus from some quarter of society to establish a medium of measurement by which an item or activity can be evaluated in a comparative way. Legget affirms that regardless of any specific categorical definition which may be applied, the standard remains, in essence, a simple point of comparison. The examples of language, written alphabets, numbers, and the Julian calendar are cited as examples of standardization efforts which had broad social motivations.(12)

Hemenway emphasizes the metrical aspect of standards in asserting that there are certain *fundamental standards* - for time, numbers, language, and weights and measures - upon which more specific applications of standardization must depend.(13) Salter accentuates these aspects still further in her observation that "standards establish a norm but also a range of acceptable and unacceptable deviations from it."(14) As

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11. Verman, p. 33. The diagramme, which Verman uses to describe something he calls "standards space," is frequently reproduced and discussed in treatments of this subject.

12. Legget, pp. 13-17.

13. Hemenway (1975), p. 4.

the discussion of proactive standardization develops, the influence of an evolved concept of fundamental standards will become apparent. Accordingly, special forms of derivative standards will be seen to have evolved in response.

To propose certain minimum educational requirements as standards for the hiring of new employees may be considered reasonable - to propose as a standard that the candidate be of a particular gender may not be. In practice, it is the identification and treatment of the particular aspect(s) of a subject to be standardized which generates most of the activity. Moreover, many standards initiatives involve standardizing an aspect which is common to several subjects. It is the "aspect" which will be seen to feature prominently in the discussion of communication and information technologies to follow. Computer manufacturers, for example, may see an advantage in standardizing interfaces between comparable functions among their various machines, but would see no advantage in standardizing these interfaces within each individual manufacturer's machines.

The "levels" suggested by Verman are derived from industrial terminology but they adequately illustrate the potentiality that a standard might migrate from acceptance by a marginal group to acceptance by an international community. It is in the "level" of standardization pursued that standards subjects and aspects become embedded in institutional processes. A standard generally acquires increased legitimacy

14. Salter, p. 20.

each time it is accepted at some designated level of authority.

At this point in the discussion, most of the primary features which distinguish standards can be said to have been identified in some form. First of all, standards are responses to particular problems and reflect the logic (or logics) responsible for the identification of the problem. Although standards may become connected with custom and tradition (as per Sen's definition), they differ from these in that they are not confined to established practices and the necessity for them is determined by day-to-day changes in social and physical needs. The possibility is thus raised that standards can be highly mutable. Secondly, the main function of the standard is to compare one item or action with another by means of identified characteristics which are considered to be measurable. This function is reflective of the third feature of the standard which is that of communal development. Standards are proposed and developed as common solutions to common problems. The fourth feature is that standards are in some measure dependent upon institutional structures for their development, application, and hence, for their legitimacy. Finally, standards are generally committed to some form of physical reference - which is to say that they are documented.

Setting Standards

Legget proffers that a standard "is that which is accepted for current use through authority, custom or general consent."(15) Each of these methods of promulgation has resonances in institutional structures, and, moreover, a standard is not confined to acceptance by only one of them.

A standard exists either *de jure* or *de facto*; simply put, it is either the result of some identifiable process set in motion specifically to set the standard, or, it is an entity which becomes accepted as a standard through use, often because no alternative is either desired or foreseen. As the discussion progresses, it will become clear that it is an oversimplification to assume that *de jure* standards are set "by design" whereas *de facto* standards are set "by default." Lecraw draws out that *de facto* standards can exist as "kept" standards; maintained by companies as proprietary devices, often tied to specific proprietary technologies, and through which various forms of monopoly advantage are gained.(16)

In order that standardization does not become a vehicle whereby the interests of one party are advanced over those of others, there is a broadly accepted notion that the standard can and ought to exist as a "public good."(17) In such a form, the standard would exist as something available to all, its use by one individual or group not resulting in diminution of its value to other actual or potential users.

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15. Legget, p. 13. Legget's exact wording is replicated by Hemenway (1975).

16. Donald J. Lecraw, *Voluntary Standards as a Regulatory Device* (Ottawa: Economic Council of Canada, July 1981, pp. 33-34.

17. The authority most often cited in this regard is Charles Kindleberger, "Standards as Public, Collective, and Private Goods," *Kyklos*, Vol. 26, 1983. pp. 377-396.

There are three fora for standards-setting which, with some overlap, correspond roughly to Legget's agencies of "authority," "custom," and "general consent." In order, these are:

(1) Standard-setting by legislative and legal process.
(2) Standard-setting by non-designated associations - These may include all manner of social groups; professional, trade, special interest, corporate, and religious.
(3) Standard-setting by designated standards developing organizations.

It is the last of these fora which has become the recognized guardian of the standard as a "public good." Standards writing organizations (SWOs in the jargon) may take several forms but are characterized in that they are all accredited in some fashion to mediate the development of standards. The great majority of these organizations exist primarily to deal with technical and industrial matters but there is nothing forbidding the extension of their mode of practice to other concerns.

At the local and national levels, SWOs may be government departments, as is the case in the Soviet Union. They may also be non-governmental organizations with special contractual or structural arrangements with a national government to lead or coordinate standards activity, as is the case in W. Germany, Britain, and France.(18)

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18. The British Standards Institution (BSI) operates under a Royal Charter. The Deutsches Institut für Normung (DIN) and the Association Française de Normalisation (AFNOR) operate national standards systems under special treaties with their governments dating from 1975 and 1984 respectively. All three organizations are national representatives to the ISO.

Alternatively, there may be a public body constituted to coordinate the activities of various public and private SWOs, as in Canada where the Standards Council of Canada accredits and coordinates the activities of two public and three private SWOs.(19) The US has a similar approach except that its coordinating body - the American National Standards Institute (ANSI) - is a private organization. There is, however, public sector involvement in US standards work through the National Institute of Standards and Technology (NIST).(20)

National standards bodies also participate in the setting of regional and international standards. The European Communities, for instance, attempt to harmonize their individual national standards through the European Committee for Standardization (CEN), and for Electrotechnical Standardization (CENELEC). Ultimately, international standards may be promulgated through international standards bodies such as the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), or the International Telecommunications Union (ITU). In this instance, participation is defined by means of national committees accredited by national standards bodies, or directly by governments.

At the level of products and services, it may be considered another characteristic of standards that the

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19. The Canadian SWOs may submit standards to the SCC for promulgation as National Standards of Canada.

20. Formerly the National Bureau of Standards (NBS).

momentum of the process is towards international acceptance of single standards. Aside from the appeal of international acceptance as a measure of the legitimacy of a standards initiative, international standards help to control a more sinister standardization rationale, that of the isolation and protection of domestic industry and the restraint of trade. Historical examples of these practices are rife, such that the 1967 Kennedy Round of negotiations for the General Agreement on Tariffs and Trade (GATT) identified standards as potential "technical barriers to trade." The resulting action, the so-called "GATT Standards Code," affirms the principle that international standards should be adopted as regional and national standards wherever possible.(21)

Designated standards writing organizations are generally organized around the principle of consensus. Conceptually, this encloses four elements. First, there must be an identification of all parties likely to be affected by the existence of a proposed standard. Second, due process must be afforded to every participant in all proceedings. Third, there must be a measure of agreement among these parties which *exceeds the authority of an agreement by simple majority.* If unanimity is seldom possible, most SWOs compensate, and thus keep the process from stalling altogether, by insisting that ballots present minimum 75 percent majorities. Finally, the

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21. General Agreement on Tariffs and Trade, "Agreement on Technical Barriers to Trade," in *Basic Instruments and Selected Documents, Twenty-Sixth Supplement* (Geneva: GATT, March 1980) pp. 8-32. The basic statement of this doctrine is found in Article 2, Sub-section 2.2.

process must be carried out *publicly* with provision for outside comment.

Verman's description of the implications of consensus are worth quoting in full.

> "Once all of these interests have agreed and a common ground upon which to base the standard has been found, the standard acquires an authority, possibly much more powerful than a legal instrument might which has secured only a 51 percent majority vote in its favour. ... (the standard) would be voluntarily followed by those who had generally agreed to its contents."(22)

A "voluntary" element is commonly appended to consensus standard-setting and refers to both process and application. "Voluntary consensus standards," as they are called, are developed by committees made up of individuals who are nominally volunteering their time to engage in standards work: following from this, the use of such standards is usually also a matter of choice.

It is important to emphasize, that voluntary standards developed by consensus in SWOs are not "stand-alone" products - they are connected to the other two fora for standards promulgation, and they are reflective of influences from these other fora. In the first place, the legitimacy of the consensus process is exploited by the legal and legislative authorities; standards developed by the SWOs can become referenced in laws and regulations, and, conversely, legal restraints such as patent and anti-trust legislation must inform and underlie the standard-setting process. There is,

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22. Verman, p. 12.

likewise, considerable input from associations which may not have a designated standard-setting function. These include organizations which hold standards as a substantial part of their *raison d'etre*, but which are not SWOs as such - user and consumer groups, for example.

The Problem of Taxonomy

Any study of standards quickly becomes mired in a myriad of terms of classification. The taxonomical problem stems both from the fact that there are shades of meaning for each commonly cited classification, but also, as David points out clearly, there is the problem that standards tend to be multi-functional rather than uni-functional.(23) It has been variously suggested that standards be classified according to use, effects, process, and even according to their information components, but this is nearly always to narrow the range of inquiry to a single perspective.

David begins to shed light on this problem by examining the question of standards *origins* - a subject closely tied to the present search for motivations.

> "... the origins of particular standards are likely to turn out to be as much a product of the institutional and market contexts as of any intrinsic qualities of the standards themselves."(24)

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23. Paul David, "Some New Standards for the Economics of Standardization in the Information Age," in *Economic Policy and Technological Performance* edited by P. Dasgupta and P. Stoneman (Cambridge: Cambridge Univ. Press, 1987), p. 211-12.

24. David (1987), p. 213.

However, like most others, David's own resulting taxonomic structure is purpose directed. It is an extension of the taxonomical problem that as standards are studied from particular perspectives - markets, policy, organizational theory etc. - the classifications tend to reflect the terms and goals of the studies. In the present work, the aim is a very general examination of the standards-setting process. Accordingly, the writer will not attempt to "solve for every term" but will offer a basic, working taxonomical scheme to which other more specialized standards terminology can be related.

Figure 2 presents the suggested scheme in diagrammatic form showing delineations of processes and forms, along with indications of direct relationships and influences among all of the elements. Some of the terms in the procedural diagram have already been explained (*de jure* and *de facto*, voluntary and consensus) - others require some explanation. Any standard set by human effort, regardless of its subject, aspect or level will be considered a "social" standard." A "natural" standard is a quasi fictional term used here to stand for any process of natural selection. It is important to indulge in this slight fiction in that social standards are directly influenced by the natural world.

Internal standards are those set by individuals and groups for their own purposes.(25) External standards are

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25. Cargill (p. 59) specifies that internal standards are developed to "enhance the use of company resources."

those set by one entity, but directed towards use by other entities. It is with this kind of standard that the processes can become highly institutionalized leading to formal *de jure* standardization initiatives by governments and SWOs. It has already been noted that voluntary consensus standards are not immune from becoming mandatory standards. In essence, however, a mandatory standard is one set by fiat and outside any formal consensus process. As illustrated, there are alternate connections. A *de facto* standard can function as mandatory if it is unopposed, or an internal standard may become accepted widely as a *de facto* standard. Likewise, there can be interplay between internal standards and *de jure* processes.

Turning to formal classification, derivative standards are those dependent on the existence of fundamental standards as discussed above. The three remaining forms describe the states of being which a standard can address.(26)

> *Descriptive* - states an optimal condition or quality for an already existing item. There is a measure of the descriptive in every standard.
>
> *Prescriptive* - states rules for the attainment of an optimal quality or condition, set in advance of the production of the item.
>
> *Performance* - a measurement of a final state which is taken independently of the means used to achieve that state.

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26. Salter, pp. 180-182. "Descriptive standard" is a much used term. Although use of the terms "prescriptive" and "performance" is not unique to Salter's discussion, she presents these in a context which is helpfully definitive. It is her meaning which forms the basis of the definitions presented here.

To give one explicative example for the use of the diagram, consider that one might have a social standard, set *de jure* by an SWO and incorporating elements of an existing *de facto* standard. It is, furthermore, a derivative standard which prescribes some action. Finally, the reason the *de jure* route was selected was primarily because the final form of the standard could be anticipated - the type of standard desired influenced the process chosen.

Towards a Motivational Definition

It was asserted above that the prime difficulty with currently accepted technically derived definitions of standards and standardization is the omission of provision for motivating factors. As has been subsequently illustrated, standards are not the result of an isolated and abstracted process geared only to the logic of the technologies with which they deal. Standards are produced, in the main, by institutional bureaucracies, with the result that they are reflections of social pressures - political, economic and even personal - which act on the process from within as well as from without.

The definition of standards and standardization to be suggested here will be presented in the form of an embryonic theoretical structure derived out of the various features of standards-setting as identified above. It should be considered less a new definition and more an elaboration and generalization of traditionally framed definitions, such that scope is allowed for the inclusion of a fuller range of motivating factors.

The skeleton of the proposed theoretical structure began to emerge in 1988 as a result of research carried out by the writer into the role of standards in technology transfer between developed and developing countries.(27) In this context, the attribute crystalized that industrial standardization was not solely a matter of the transfer and adaptation of specific technical specifications, but also of general attitudes and belief systems specific to the already industrialized world. This was a corroboration of Salter's basic contention that standards are reflective of social attitudes towards scientific and technical processes, and that once adopted, standards become appended to the prevailing social value system as representations of desired qualities and conditions.(28)

Olle Sturen, a senior ISO official, wrote in 1982 that various attitudes and motivations pertaining to standards could be likened to national attributes, such that there were approaches which could be labeled "Japan-like," "German-like," "US-like," and so on.(29) These observations are resonant

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27. Richard Hawkins, "The Democracy of Technology: Standardization as a Communication Medium in the Transfer of Technology to Developing Economies," Draft paper, Simon Fraser Univ., Dec. 11, 1988.

28. Salter, pp. 23-24.

29. Olle Sturen, "International Standards Can Open Up New Markets," in *World Standards: Tools For Trade and Development*, Proceedings of the thirty-first annual conference, Standards Engineering Society (Minneapolis: SES Inc., 1982), pp. 4-5.

with those of David as he points out the non-separable nature of the "behavior" standards and the "technical" standards which he uses as the basis of his own taxonomy.(30)

Cerni draws attention, furthermore, to various personal qualities deemed necessary for the successful completion of a consensus standards initiative.(31) The validity of these observations became clear to the writer during the interview stage of the present research, in which national, corporate and personal motivations emerged from among the interview subjects. Standardization succeeds or fails depending upon the level of respect - professional, technical, organizational, and personal - shared between the participants, and upon the *perceived clarity of their motivations*.

The most radical swing in the philosophy of standards definition is surely that represented by Carl Cargill. These views are substantially a product of the investigation of specifically information technology related standards, although they are based in a much more universal conceptual definition of what standards are:

> "... a standard is the deliberate acceptance by a group of people having common interests or background of a common quantifiable metric that influences their behavior and activities by permitting a common interchange."(32)

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30. David, p. 215.

31. Cerni, pp. 190-196.

32. Cargill, p. 13.

Cargill proceeds to adapt this definition specifically to a discussion of standards and market relationships (this emphasis will feature prominently in later chapters). Here, the definition of standards is placed squarely in a behavioral/motivational context. Cargill's first perspective is that of the standards-setter and the second that of the standard itself.

> "Standardization is the product of a personally held belief that the market has the ability to understand and chart a valid future direction through the use of collective wisdom, to understand the impact of change on itself, and to adjust itself to that change. The specific change agents utilized in this process are collective technical descriptions of how things ought to be and function, called standards."
>
> "A standard, of any form or type, represents a statement by its authors, who believe that their work will be understood, accepted, and implemented by the market."(33)

Elements of these definitions will feature later on - they are introduced in the present context as a way of introducing the preliminary theory/definition which will inform the rest of this discussion.

Definitions derived from applications of standards generally fail to describe the activity adequately because they focus only on the application of the phenomenon and not on the phenomenon itself. It is proposed here that there are two levels to the process which act simultaneously, and are inseparable. Moreover, both of these levels can be and are expressed institutionally.

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33. Cargill, pp. 41-42.

Primary Level - This is comprised of the broad, socially determined concepts, attitudes, and motivations which underlie the process of standardization. Taken together, these constitute the means by which existing standards are given legitimacy and by which the perception of the need for further participation in standards activity is communicated. At this level, the standard is an emblem of these concepts, attitudes and motives.

Secondary Level - This comprises the processes by which standards are set and applied according to individually determined circumstances. At this level, the standard is a product, created in response to a specific need.

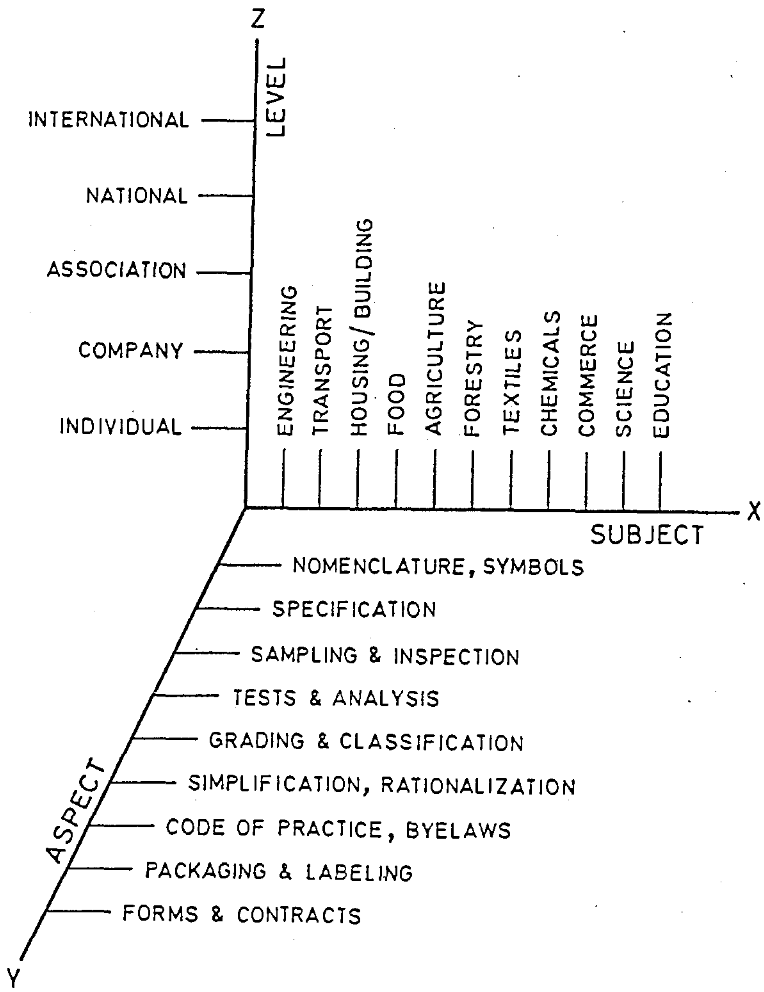
The technically framed definitions examined so far are not inaccurate, they are merely definitive of the Secondary Level only, as it is applied to industrial needs. The imposition of a Primary Level provides room for less traditional perspectives, like those of Salter and Cerni, and for Cargill's more radical concepts.

Keeping the two levels in mind - two simple and generally applicable definitions are proposed:

Standardization is the result of action taken in the belief that increased value or benefit will accrue from the collective identification of problems, and from the collective establishment of a specific form of solution.

A standard is a comparative reference which defines a collectively identified method of solution for a collectively identified problem.

FIGURE 1



Diagramatic Representation
of Standardization Space

From L. C. Verman, Standardization: A New Discipline, (Hamden: Archon Books, 1973).

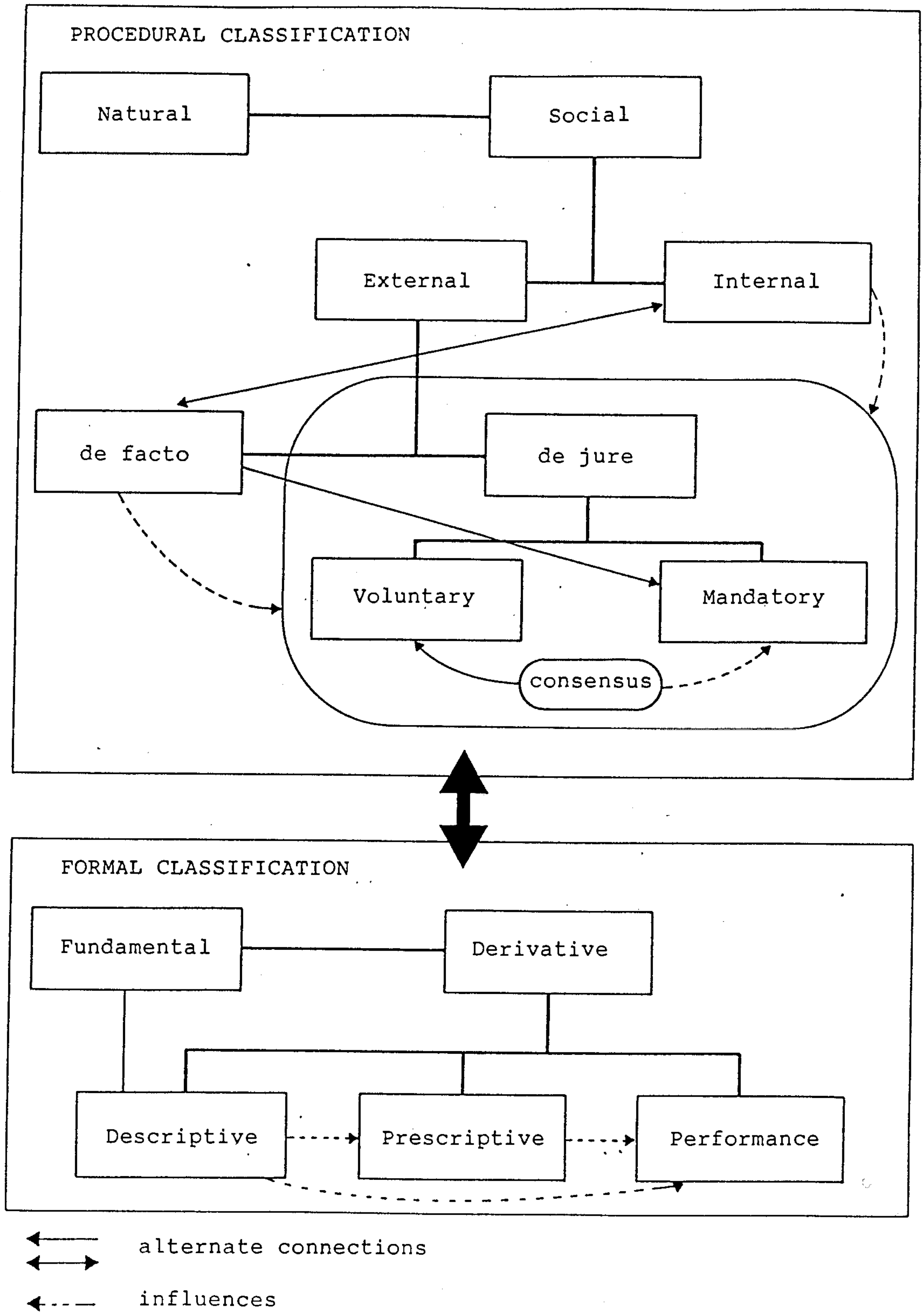


FIGURE 2

Standards Taxonomy

Chapter 3

The Nature of Standardization in Communications and Information Technology

The terms "communications" and "information" have become fused in the current environment in order to take account of emerging systems concepts. The terms began life, however, by defining two distinct sectors with different rationales and industrial cultures. The lineage of "communications" is telecommunications, denoting the carriage of messages over distances via telephone and telegraph based media. "Information," by contrast, is a term traceable to what used to be referred to as "data processing," denoting the mechanical manipulation of information. As already mentioned, the tradition was for the two spheres to be logically and legally separated.

The acronym "CIT," (for Communications and Information Technology) has been settled upon for use in the present work in order to specify that the technologies and processes to be examined are concerned with phenomena arising from the integration of these areas. "CIT" is not an acronym unique to this writer, but neither is it one in common use. By far the most common term to describe this subject area is "IT" (for Information Technology), to which the matter of communications is generally appended. This term is rejected here for perspectival reasons; it accurately reflects neither the respective roles of the two sectors, nor their relationship. "CT" (communications technology) is similarly exclusionary.

The OECD Committee for Information, Computer, and Communications Policy (ICCP) has adopted "I & C technologies" (for Information and Communications), as its internal generic classification - "CIT" seems a more concise and inclusive derivative of IT and CT.

This concern for a suitable term may appear petty, but it is indicative of the prevailing unsettled relationship between the two entities involved. Treatment of the standards issues which have emerged in CIT will acquire proper perspective only if the sectors are first examined in isolation, and an assessment is made of the accustomed role of standards in each sector.

Standards for Communications Technologies

Until the 1970s, telephone and telegraph based communications systems had normally been treated as natural monopolies.(1) In such an environment the rule, perforce, is *de facto* standardization based on technology proprietary to the operating monopoly. There used to be virtually complete vertical integration in the global telecommunications industry, with monopoly service providers either owning or controlling the equipment manufacturers, or otherwise being in a position to dictate what equipment would be manufactured and to which specifications. Furthermore, as Tamarin indicates, the service provider was also in a position to dictate service needs to the user.(2) In this climate, the only requirement

1. By "natural" monopoly, the rationale is meant that the initial cost of providing the necessary network is high enough so as to preclude the possibility of a competitor entering the market.

for negotiated standards was at the point of connection with the international network.

This state of affairs began to break down significantly in the late 1960s. When applied outside the realm of basic telephone services, the natural monopoly rationale was found to be seriously eroded by advances in technology. It became evident that new switching and network technology, as well as transmission facilities (such as satellites, microwave, and fibre optics) could often be developed and deployed *to economic advantage* by competitors to the telephone monopolies.(3) Such significant recent developments as the divestiture of AT&T in the US have in large measure been reflections of these pressures.

Besen and Saloner note three reasons for the lessened profile of an industry giant like AT&T in standards setting. Firstly, there is an increase in the proliferation and size of competitive service and equipment suppliers. Secondly, AT&Ts forced divestiture has fragmented the industry. Thirdly, there is reduced autonomy for all national systems in standard-setting as the momentum for the activity shifts to international bodies. Tied to the third reason, moreover, the market for telecommunications equipment has moved from the

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2. Christopher Tamarin, "Telecommunications Technology Applications and Standards: A New Role for the User," *Telecommunications Policy*, December 1988, pp. 324-5.

3. As thorough and concise a discussion of these trends as can be found is contained in a study prepared by the OECD's Department of Science, Technology and Industry entitled *The Telecommunications Industry: The Challenges of Structural Change*, (Paris: OECD, 20 January 1987), pp. 51-69.

national to the global arena.(4) Reasons one and three pertain equally well to other national monopoly structures past and present.

Historically and currently, the most vital distinctive characteristic of standards for telecommunications is that irrespective of the mechanisms which produce them, standards are the life-blood of the enterprise. As expressed by a senior communications technology research official during an interview, every issue in telecommunications is in some way a standards issue as the logical goal of the endeavor is complete connectivity. Without standards there simply is no system!

Following the breakup of the US Bell System in the early 1980s, one of the chief concerns became how to ensure the integrity of the network's connectivity standards. The result in this case was the establishment of the "T1 Committee," an accredited SWO to develop and coordinate these standards.(5) Cohen and Wilkens, moreover, proffer an expanded role for standards in the new competitive networks in order to respond to increased customer service demands, and to the altered regulatory environment.(6)

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4. S. M. Besen and G. Saloner, "The Economics of Telecommunications Standards, in *Changing the Rules: Technological Change, International Competition, and Regulation in Communications*, edited by R. Crandall and K. Flamm (Washington: The Brookings Institution, ca. 1988), pp. 177-8.

5. I. A. Lifchus, "Standards Committee T1 - Telecommunications," *IEEE Communications Magazine*, Vol. 23, No. 1, January 1985, pp. 34-37.

6. E. J. Cohen and W. B. Wilkens, "The IEEE Role in Telecommunications Standards," *IEEE Communications Magazine*, Vol. 23, No. 1, January 1985, p. 31.

Standards for Information Technologies

Since the 1950s, information processing has been tied to the development of computer systems. Concerns about the possibility that a dominant computer supplier might be able to structure the market so as to inhibit any use of component and peripheral hardware supplied by competitors led, in 1969, to an anti-trust suit against IBM Corporation.(7) The difficulty in this instance, however, did not revolve around arguments that the "installed base" of computing equipment constituted a case for natural monopoly. Rather, the concern was about the possibility that a monopoly of sorts might stem from questionable business practices.

Until recently, standards in the computer industry were largely *de facto*, and based on the proprietary technologies of various suppliers. Standards became an issue in IT because of three somewhat successively derived factors. First, the move away from centralized computing facilities (ie "mainframe" installations and/or "time-sharing") to decentralized facilities such as "mini-mainframes" and various types of "personal" computers. This led to an architecture lending increased scope for the competitive production of individual components by specialist firms. Second, decentralization mandated the linking of individual computing stations to each other in networks. Third, and most important in the present

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7. See M. Fisher et al, *Folded Spindled and Mutilated: Economic Analysis and "US vs IBM"* (Cambridge Mass.: MIT Press, 1983) pp. 6-17 for a background to the various litigations involving IBM and the role played by standards in creating the environment in which these actions were brought.

context, it became obvious that data could be transmitted over distances using the telecommunications infrastructure.

Convergence

The rationales for standards in the communication and information sectors began to merge substantially as they came to share the need to operate as networks. It is valuable at this juncture to refer to the "interface" keyword. Stewart defined standards for telecommunications as the rules governing "the electrical and mechanical behavior of the interface."(8) It is clear that this definition now holds true for many computing applications as well.

There is, however, another strong link between CT and IT in digital technology. Until recently, telephony has reflected its roots as a carrier of voice messages only and has been an analog process utilizing largely mechanical switching devices. New generations of telephone technology are heavily computerized. Indeed, the most ambitious telecommunications initiative of the 1980s is the developing Integrated Services Digital Network (ISDN) whereby all voice, data, and even video signals could eventually be transmitted in digital form via a single connection. What is more, communications firms are developing profiles in the computer business and computer firms are expanding into communications.(9)

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8. Alan Stewart, "A User's Guide to ISDN Standards," *Telecommunications*, May 1988, p. 34.

9. AT&T, for example, is the proprietary owner of the UNIX operating system for computers, the basis of most of the serious competitors with IBM

Organizational Structures for CIT Standards

Faced with the emergence of CIT as a cooperative infrastructure, standards developed for one sector will inevitably impact on the other. A potential difficulty is that the prime responsibility for international standards-setting in each sector has traditionally been allocated to separate and very differently constituted organizations.

Stemming from the necessity to coordinate standards with various regulatory functions, cooperative standards development for international telecommunications is the responsibility of the International Telecommunications Union (ITU) which has the task of managing the global communications infrastructure. The ITU is not a standards-writer in the conventional sense; rather, it is a treaty organization comprised of member governments, along with various membership categories for scientific, technical, and industrial organizations. A significant membership category is the Recognized Private Operating Agency (RPOA); open to any private telecommunications operator recognized for the purpose of ITU participation by a member state.(10)

Standards related work in the ITU is carried out primarily by two International Consultative Committees (CCIs). The CCI for Telephony and Telegraphy (CCITT) deals with

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operating systems. IBM has been making forays into telecommunications, as illustrated by its recent alliance with Rolm Corp., a telecommunications equipment supplier.

10. See A. Rutkowski, *Integrated Services Digital Networks* (Dedham: Artech House Inc., 1985) pp. 5-19, and D. M. Cerni, *The CCITT: Organization, Participation, and Studies Toward the ISDN* (Washington: US Dept. of Commerce, 1982), pp. 21-23.

matters conceptually related to wire based services. The CCI for Radio (CCIR) deals with matters requiring radio spectrum use. All aspects of CIT relating to carriage of signals - voice, data, or image - over public networks are necessarily referred to ITU committees. Although Study Groups, Technical Committees, and Working Groups of the CCIs operate by consensus, the standards they develop are not fully considered to be ITU Recommendations until they are accepted by the Plenary Assemblies of the CCIs according to a one-country-one-vote principle. A significant new development respecting this procedure will be discussed in Chapter Eight.

As IT standards issues originally flowed not from the telecommunications sector but from the office machine and data processing sector, responsibility for international standards was already resident at the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).(11) Nations are represented in both of these organizations by their acknowledged national standards coordinating bodies, placing ISO and IEC at the pinnacles of the "voluntary consensus" standards development process. IEC deals with standards for the actual electrical components related to CIT and ISO deals with matters of process - connectivity and compatibility.

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11. The ISO was created in 1947 by the United Nations and became an official non-governmental consultative body to the UN in 1970. ISO is the principal organization for the setting of international industrial standards of all kinds with the exception of electrical standards. The IEC is an older organization (1904) and although it retains an independent internal structure it now functions as the ISO arm dealing with electrical standards.

Given today's convergent technologies, there is considerable overlap of interests, both between ITU and ISO/IEC, and within these organizations themselves. For example, a proposal was submitted for consideration at the 1989 Plenipotentiary Conference of the ITU in Nice that the CCITT and CCIR have their secretariats formerly merged.(12) The CIT activities of IEC and ISO were formally coordinated in 1987 with the formation of a Joint Technical Committee 1 (JTC 1).

Liaison between the ITU and the ISO/IEC is at the formal level only insofar as ISO is a member of the ITU. The ISO/IEC Special Working Group for strategic Planning (established with JTC 1) is expected to forge closer contacts with the CCITT.(13) Primarily, though, it is through the participation of the *same technical experts* in several committees in different SWOs that most of the coordination as exists in CIT standardization is maintained. This practice was confirmed in all of the author's interviews with actual participants in SWO working groups whenever the subject of liaison was introduced.

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12. The proposal was brought by the Republic of Indonesia. This has superficial significance in that high costs are a factor militating against full participation in ITU standards-setting by developing countries and any merger of functions could well result in some cost reductions. However, interviews with CCIR and CCITT officials indicate that the source of the amalgamation proposal was the Secretariat of the ITU itself, suggesting some broader rationale than assistance to developing countries. The Indonesian proposal was not accepted.

13. Julian Bogod, *Information Technology Standardization: A Report to BSI and DTI*, (London: UK Dept. of Trade and Industry, 9 Feb. 1989), p. 12. V. C. MacDonald, "Standardization: Today's Key Arguments," *Telecommunications Journal*, Vol. 54, April 1987, pp. 254-255.

CIT standardization also takes place at regional and national levels and assumes a two-way relationship with the international level. Input into the ITU and ISO fora comes primarily from regional and national interests. Likewise, once international standards are promulgated, they become basic documents for national and regional "versions" of these standards. As Cargill points out, standards can be written "with multiple subsets to satisfy different national requirements."(14) Probably the most ambitious regional standards initiative at the present time is that being coordinated by the Commission of the European Communities in conjunction with the planned European economic union in 1992.(15)

Further CIT standardization activity is often entrusted to the Institute of Electrical and Electronics Engineers (IEEE), a professional association with a membership of individual engineers rather than national or corporate delegations. Accredited as an SWO by ANSI, the IEEE has concentrated on standards for computer communications.(16)

At the national level, active member states of the ITU maintain national committees to track developments and to

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14. Cargill, p. 151.

15. Commission of the European Communities, DG XIII, *Standardization Fact Sheet Number 3: Community Standardization Policy* (Brussels: May 1988). Also see Bogod, p6.

16. For a description of IEEE activity in telecommunications see Lifchus (1985). The IEEE 802 Committees have developed standards for Local Area Networks (LANs), and the 1003 Committee has developed a portable operating system - POSIX - which is based on AT&Ts UNIX.

formulate national positions from among the interests of the domestic telecommunications sector. These are normally attached directly to government departments.(17) The international activities of JTC 1 are likewise tracked domestically, but through committees accredited by the national standardization bodies. In Canada, the Canadian Advisory Committee to JTC 1 is maintained by the Standards Council of Canada and mirrors exactly the committee structure of the international body. A significant link between ISO/IEC and the national standards bodies is the practice of establishing the international secretariats for specific standards projects within national organizations. The international secretariat for JTC 1, for example, is held by ANSI.

Individual national SWOs, in concert with organizations, both national and international, representing manufacturers, service providers, and users, also play a significant part in CIT standards. As mentioned, national standards may progress towards being accepted as regional or international standards. An example of this process as it concerned standards for Videotex will be given in Chapter Seven.

Pressures and Tensions in Standardization for CIT

Many residues of the separate industrial cultures of data processing and telecommunications permeate the convergence of these sectors. Burtz and Hummel make it clear, that the

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17. For example, the Canadian National Organization (CNO/CCITT) is headquartered at the federal Department of Communication. The US/CCITT is headquartered at the State Department.

telecommunications system continues to be bound by the rationale of having to provide a level of "basic" service.(18) No such concept has evolved in the computer sector, nor is it particularly appropriate that this occur - computing has historically been task oriented whereas telecommunications is service oriented. Also, common standards are necessary throughout the telecommunications system whereas they are presently only desired on a selective basis for computing.

In an era when "deregulation" is beginning to feature prominently in discussions about communications, a further tension is bound up with the changing role of national governments with respect to CIT. Policy initiatives are presently fluctuating between traditional concepts of regulation and new strategies for promoting national industrial objectives.

Butler indicates that should the ITU CCIs fail to keep pace with the tremendous speed at which CIT is developing, the possibility exists for them to be by-passed altogether.(19) It would be incorrect ever to assume that the demarcation lines between SWOs involved in CIT are inviolate, especially bearing in mind the close connections among personnel which have already been noted.

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18. L. Burtz and E. Hummel, "Standard Setting in International Telecommunications," *Telecommunications Policy*, March 1984, p. 6.

19. Richard Butler, "In Pursuit of Excellence: A Critical Choice," speech given in Washington DC, 27 April, 1989, p. 6. Butler was the outgoing Secretary-General of the ITU at the time this speech was given.

Emerging standards issues often have no logical "home" within the present organizational structure. High Definition Television, for example, is presently the bailiwick of the CCIR, the traditional body handling broadcasting technologies. The problem is that the greatly increased radio spectrum requirements of HDTV may well mandate its carriage over cable or optical fibre networks, thus overstepping the boundary between "wired" and "non-wired" services. Moreover, even if bandwidth requirements were not at issue, the scope for HDTV applications outside of broadcasting is large. An interview with a computer scientist engaged in computer workstation applications for HDTV yielded the observation that the CCITT and the ISO/IEC might well "poach" on the CCIR's ancestral territory in instances like this. Alternatively, some third party could march up the middle.

Formal Function of CIT Standards

Referring back to the classification system suggested in the previous chapter, the above discussion describes the upper (procedural) half of the diagram. Turning attention to the formal classification of CIT standards, the exact ways in which this terminology will apply to CIT will become clear as the discussion develops. For the present, suffice it to say that there is scope for argument as to whether CIT standards are or ought to be of a fundamental or derivative nature. Although all of the terms describing states of being can be applied to various facets of CIT (hardware, software, systems design and so on) it will emerge that standards for CIT are primarily *performance* orientated. This assertion follows from the principal integrating feature of the field which is the perceived user desire for complete end-to-end connectivity and compatibility. In the treatment of the matter of proaction which is yet to come, the pursuit of ends rather than means will be seen as the guiding strategy for CIT standardization.

Chapter 4

Participation in Setting Standards for CIT

Over the past decade, a complex of interest groups has evolved in the CIT area, and, not surprisingly, the demarcation lines between various classifications of interests have often become as blurred as those between the applications of the technologies. Hence, the above insistence on a motivationally framed definition for standards and standardization. Ambiguities of interest have had profound effects on both the procedures and the institutional structures of standard-setting. It is necessary at this juncture to compare some traditional rationales with the exigencies posed by CIT.

Traditional Advantages and Disadvantages of Standards and of Participation in Standards-Setting

The matter of the desirability of the existence of a standard can be approached from both technical and socio-economic perspectives, often resulting in disparate conclusions. The technical perspective is the most straightforward - it is normally always a technical advantage to have common recurrent technical conditions addressed through recourse to a standard. Such a technical solution, however, may not serve all other interest sectors equally. The inherent diminution in choice effected by standardization or some level of coercion deemed necessary for its enforcement may or may not be seen to have social or economic benefit.

Liberal economists have historically had a negative view of standardization, viewing it as an impediment to the free marketplace. This view was formed, however, in a less technically complex era in which there was greater self-sufficiency within manufacturing firms, and in which the market could be more accurately said to have been adequate for the provision of product information.(1) It is now seen that many forms of standards - chiefly those affording interchangeability of components - actually break down barriers to market entry.

Nonetheless, there are obvious advantages accruing to individual firms should they be able to promote and maintain acceptance of their own proprietary technology as a *de facto* standard. Referring back to the writer's suggested definition of standardization, there clearly must be some factor militating against the maintenance of such *de facto* standards in order to provide soil in which a standardization initiative may grow.

It is possible for standards to "stand in" for regulations. Such things as building and electrical codes are most often cited as examples of this practice. This use can be extended, however, to include such matters as the regulation of competition. Saloner points to the example of US telephone service deregulation, in which mandated

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1. D. J. Lecraw, pp. 51-52. Lecraw views the information deficit inherent in ever more complex products, or in products with increasingly diverse applications as a prime cause of the kind of market failure correctable by the existence of a standard.

interconnection places standards in the role of guarantors that competitive access to the system will not be impeded.(2)

Especially in the present context, there are clear advantages to participating in standards work for the purpose of information gathering. This was a commonly acknowledged rationale among virtually all interviewees. This "intelligence" rationale may take two forms. It may reflect concerns that a competitor firm does not acquire special advantage in the promotion of a standards initiative. Alternatively, it may reflect the desire for clarity in interpreting the finished standards. As Cerni and Gray suggest, "Active participation...minimizes the risks associated with the individual interpretation of any standard."(3)

The principle disincentive for undertaking standards work has traditionally been the notoriously high costs which are largely due to the extended time frame usually attached to standards development. Although participants in "consensus" standards development are officially "volunteers," their expenses are most often met by their employers and the very practice of "seconding" an employee to a standards committee constitutes a form of subsidy. As progress is always more

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2. Garth Saloner, "Economic Issues in Standardization," in *Telecommunications and Equity*, edited by J. Miller (n. p.: Elsevier Science Publishers, 1986), pp. 167-68.

3. D. M. Cerni and E. M. Gray, *International Telecommunication Standards: Issues and Implications for the '80s* (Washington: US Dept. of Commerce, May 1983), p. 55.

difficult to perceive over extended periods of time, these costs may become hard to justify.(4)

The other main concern about standards is their effect on innovation. The question revolves around the extent to which a standard "freezes" a technology such that innovation becomes impossible. Lifchus expresses confidence that in the consensus mode, there is less likelihood that industry will adopt a standard which will limit innovation.(5) On the other hand, Farrell and Saloner present a good case that where new technologies appear, the presence of any existing standard may engender "excess inertia" in the market such that newer technologies and standards are not accepted.(6)

The Negative Rationale

At one point in the course of the interviews, the question was asked of a senior executive in a communications technology firm as to what he saw as the primary advantage of participation in standards work. The immediate and succinct reply was "damage control." While not denying the advantages of standardization when the terms were favourable to his firm,

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4. As an example, In July 1989, the writer had opportunity to do field studies at the Plenary Session of the IEEE 802 Committee on Local Area Networks (Hotel Vancouver, July 10-14, 1989). During an organizational session, the proposal was tabled to hold a future Plenary at a resort in Hawaii. Many delegates expressed extreme concern that this would make it impossible for them to justify requesting leave and expenses from their respective firms.

5. I. M. Lifchus, "Standards and Innovation: The Hidden Synergy," in *Telecommunications and Equity*, edited by J. Miller (n. p.: Elsevier Science Publishers, 1986), p. 180.

6. J. Farrell and G. Saloner, "Standardization, Compatibility, and Innovation, *Rand Journal of Economics*, Vol. 16, No. 1, Spring 1985, p. 71.

he was adamant that it was just as important to *prevent the adoption* of a standard should it be contrary to the firm's interests or *to minimize potential ill effects* from such a standard.

The existence of a negative rationale was acknowledged by most of the individuals interviewed. Understandably, promoters of standards initiatives and officials in SWOs expressed views to the effect that preliminary study of the proposals at the Study Group or strategic planning level (where this exists) should eliminate standards questions at the outset where little hope of a positive consensus could be foreseen. The view from the industrial sector was decidedly less sanguine.

A variant of the negative rationale might be called "speculative participation." In such a case, a firm having technology which is currently accepted as a *de facto* standard may participate in the development of an alternative *de jure* standard if it is clear that such an initiative may be attracting wide support among component suppliers and users. An example of this is the current attitude of IBM towards the emergence of the ISO set of hardware independent standards for computer networking (the Open Systems Interconnection or OSI). IBM participates in this work while at the same time aggressively promoting its own Systems Network Architecture which is essentially bound to IBM hardware.

Sectoral Perspectives on CIT Standard-Setting

In order to begin to identify perspectives from which differently motivated standards initiatives might emerge, five broad sectoral interests are suggested: (1) *equipment suppliers, or vendors* (including manufacturers of systems and of components), (2) *network providers* (public or private common carriers), (3) *users*, (4) *governments* (may include intergovernmental organizations), and (5) *professional interests*.

A recent OECD study of CIT standardization uses a similar list of sectors and draws out various strategies which might emerge from each perspective.(7) Several key points are brought out in this study. Firstly, the perspective of the supplier sector in computing has changed significantly in recent years. This has been in response to the increasing sophistication of the user who is no longer apt to accept the position of being dependent on a single supplier for the definition and solution to CIT questions. As the user now demands an interconnectivity potential as a basic systems feature, there is greater incentive for the suppliers to support some manner of standards development. In this, computer suppliers have been forced to adopt a version of the traditional telecommunications standards rationale. However, as expressed in interview by an information technology analyst

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7. OECD, ICCP, *Standards in Information and Communications Technology* (Paris: OECD, 1987), pp. 14-27, 42-49. The sector identified in this study are: (1) systems suppliers, (2) networks (or carriers), (3) component suppliers (4) market creators, (5) Users, and (6) Governments. There is no consideration of the role of individual professionals.

for the Commission of the European Communities, it is seldom in the interest of an IT supplier to promote identical technology such that the user retains no ties of any kind with the supplier.

A second major point from the OECD study is the close connection between standards development and the creation of markets for new CIT technology.(8) This leads to a third point which is the existence of conflict in the user community between the desire for new standards to ensure interconnectivity and the problem of already installed bases of equipment to which, in many cases, the new standards cannot be applied.

The final observation of the OECD study concerns the role of governments. Governments can influence the standards process in two principal ways. They can intervene directly in terms of their ability to direct the market by dint of their procurement power, and they define the regulatory structure governing the interaction of the elements involved in CIT - telecommunications, commercial and trade policy, and so forth. For all their power and influence, however, governments are largely unable to influence CIT standardization application through national standards bodies by virtue of the fact that this matter is fundamentally controlled at an international level.

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8. OECD, *Standards in Information and Communication Technology*, pp. 18-19.

Perhaps the major observation to come out of the OECD study is one which must largely be inferred. This is the general ambiguity of interests between the sectors as imposed by the varying measures of common interest in interconnectivity. As a tool for beginning to disentangle these often complex intersections, the writer would support an approach proposed by Sirbu in which motivation for the nurture of standards initiatives is connected with the mode of industrial decision making - whether this is centralized or decentralized.

> "Decision making is said to be *decentralized* when separate, independent entities control parts of a system that must be made compatible for the system as a whole to function."(9)

Sirbu extrapolates this principle into a matrix with "centralized *vs* decentralized" manufacturers on one axis, and "related *vs* unrelated" buyers on the other. The resulting scenarios are:

> (1) *related buyers/centralized manufacture* - little incentive to accept the cost of developing a standard;
> (2) *unrelated buyers/centralized manufacture* - buyer pressure as "diffuse buying...imposes significant costs in the absence of a standard;"
> (3) *related buyers/decentralized manufacture* - pressure for standards but not necessarily for *unique* ones;
> (4) *unrelated buyers/ decentralized manufacture* - maximum pressure for standards to be developed.(10)

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9. Marvin Sirbu, "Telecommunications Standards, Innovation and Industry Structure," paper presented at the IIC Telecommunications Forum, Feb. 6 & 7, 1989, Washington DC, p. 11.

10. Sirbu (1989), pp. 11-13.

The "Problem" of the User

Perhaps the most difficult CIT sector to define with any accuracy is that of the user. The role for the user in standards development is correspondingly difficult to identify. At the outset, as has been shown, there remain "cultural" residues of the era when IT and CT users were far more separable than they are at present. Furthermore there is the question "user of what?" - are we speaking of network use, systems use, or component use (either hardware or software) or combinations of these? There is also the question "direct user of standards, or user of conforming products?" Depending on how these questions are dealt with, suppliers and carriers may also be users - the current battle over computer operating systems (the portable UNIX or the tied IBM OS II?) is an illustration of this.

There are also different structural classifications possible within the user community. There is the phenomenon of the "mega-user" (a situation most obvious in the government sector) in which sheer procurement volume results in tremendous influence over which standards succeed and which do not.

An often cited corporate example concerns the development, chiefly by General Motors Corp., of the Manufacturing Automation Protocol (MAP). Unsatisfied with external progress toward development of a shop-floor automation network protocol, GM developed one internally which has now become widely applied throughout the international industrial sector. GM is certainly a user in the technical sense, but it is hardly the average user.

It is an irony that although the user is usually identified as being the prime beneficiary of standardization (particularly the small or first-time user), this group is the most difficult to organize in such a way as to make institutional impact on the standards process. In addition to the definitional ambiguities, there are two main reasons for this. Firstly, most individual users do not have the resources to sustain the expense of participation in standards development. Secondly, as Cargill emphasizes, the interest of the user is normally short-term whereas the trends in standard-setting tend to be long-term.(11)

Several consortia with user orientations have emerged in response to the development of OSI, the best known of these being SPAG (Standards Promotion Applications Group) and COS (Corporation for Open Systems). These consortia remain dominated, however, by equipment suppliers with an interest in the proliferation of the OSI concept. Their role to date has been principally in "functional" standardization - standards selection for particular applications - and in OSI conformance testing.

One common element running through the entire standardization debate is that there must emerge an effective mechanism whereby the needs of the user may be identified at the beginning of the research and development process and from

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11. Cargill, p. 47.

there integrated into standards questions. Tamarin gives a synthesis of often cited elements of user rationale:

> "Users have a vested interest in encouraging the adoption of international standards ... in order to build and maintain an open network that is uniformly accessible. This will serve to meet user telecommunication needs and facilitate world commerce."(12)

This leaves open the annoying question of the extent to which the user is actually in a position to define the service needs, let alone the required standards. In the absence of comprehensive research which accurately specifies the *role* of users in CIT standardization, all that can presently be maintained with any certainty is that the *profile* of the user community is gaining an ever increasing prominence among CIT goods and service providers in direct proportion to the ability of the user to make independent needs assessments.

The Role of Professional Interests

The term "professional interests" refers here to individuals who perform standards work, partially or totally, for reasons arising from their personal involvement with the technologies at either technical or managerial levels.

Standardization is carried out by individuals contributing to a common effort in an area where they have particular expertise. Affiliations taken into account, it must not be discounted that a prime motivation can be or *can become* the very accomplishment of a complex and demanding task. Institutionally, this rationale finds perhaps its best

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12. Tamarin, pp. 329-330.

expression in the IEEE, which is primarily a professional association of individual engineers. Field work done by the writer at a recent Plenary Session of an IEEE standards working group revealed this personal rationale to be much in evidence.(13) General sessions included discussion of such matters as how to integrate standards work and professional ethics, and the treatment of intellectual property.

As CIT standardization often deals with leading-edge technologies, there can also be substantial involvement by the academic community. Even in cases where this involvement is supported by specific, directed government or corporate sector initiatives, the inclination of the academic to "explore" can effect the direction of the standards process. Interviews in the corporate sector also suggested that "free-lancing" - the taking up of standards work by an employee for personal motives rather than corporate objectives - is a matter of legitimate concern to managers.

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13. IEEE 802 Committee - Local Area Networks. Plenary Session, July 10-14, 1989, Hotel Vancouver, Vancouver BC.

Chapter 5

Proaction in Standards-Setting

The term "proaction" is not encountered frequently in the literature on standardization. Nevertheless, its occasional use is significant as, conceptually, the term represents a substantial revision of traditional standards-setting practices, or even an antithesis to these practices. In order for the writer to determine if such a mode of practice actually exists, or otherwise to gain an appreciation of the implications of proactive standards, it became necessary to go beyond the literature and to discuss the term with individuals actually involved, from a variety of perspectives, in the standards-setting process.

Interviews revealed that among participants the term is a common element of the standards discourse. Problematically, though, the explanations and definitions proffered were sometimes found to be highly divergent, even among those approaching the matter with a similar participatory rationale. Opinion ranged from flat denial that proactive standards are possible to open advocacy of the concept. All of the interviewees with whom the subject of proaction was broached had a sufficiently developed sense of the term to be able to substantiate their assessments with specific, often detailed illustrations.

Looking back to the discussion in Chapter Two, it is clear that the accepted logic for standards development according to the definitions accepted in the technical standards community is that the process is essentially *reactive* in nature. Although standards have a future orientation, they are based on a consolidation of experience.

Historically, nowhere has this been more true than in formulating regional and international standards. For example, the predecessor organization of the ISO was devoted almost entirely to coordinating and harmonizing standards developed domestically by its member states.(1) Much of the current ITU activity is likewise concerned with forging international standards out of existing national ones.

One interviewee, although a proponent of proactive standards, nonetheless maintained that *de facto* reactive standards are normally the best *technical* choices. If it is accepted that there are wider advantages to be gained from a *de jure* standard, it must be also accepted that the result may incorporate technical and political "horse-trading."

Perhaps the most important fact to grasp about all forms of *de jure* standards is that they require very long time frames to develop - typically three to five years for national standards, and substantially longer for international ones. Traditional reactive standards have been predicated on the assumption that the technologies involved were mature and stable. Rapidly changing fields like CIT which are tied to the enormous increase in international trade to have occurred

1. The organization in question was the International Federation of National Standardizing Associations (ISA), founded in 1926 and remaining in existence until 1944. See Legget, p. 142.

over the past two decades present the most direct kind of challenge to reaction as the guiding concept in standardization. Perhaps the prime concern to have sparked debate over the traditional modes of standards procedure has been the realization that the "life cycle" of CIT products is forever getting shorter whereas standardization practices tend to remain locked into the rhythm of less dynamic product sectors.

Green articulates this problem for standards generally as he argues that they should be conceived of as "fundamental bases" for technical development rather than always as the "consensus of practice" existing at any given time. With this approach, Green asserts, the problem of "early" standards being confronted by new expertise can be mitigated.(2) Green's use of the term "fundamental" is a deliberate reference to metrology and it is used to provide a comparative horizon: Standards must act as points of reference upon which future innovations can be built.

Origins of the Proactive Concept

Sullivan distinguishes between "active" and "reactive" modes of standardization. "Active" standards are those which appear at the same time as the technologies to which they refer. "Reactive" standards follow the application of a technology. In Sullivan's description, these terms refer more

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2. Eric Green, "Consensus or Fundamental Standards?" in *World Standards: Tools for Trade and Development*, Proceedings of the Thirty-first Annual Conference, Standards Engineering Society (Minneapolis: SES Inc., 1982), p. 274.

to the timing of regulatory standards for the civil control of a technology rather than to standards of compatibility or interoperability. Nevertheless, Sullivan's concept of the "active" standard is significant because it maintains that planning for both development and use can (and should) become infused into the standards-setting process itself.(3)

The root cause for the kind of conceptual change - from reaction to proaction - which will feature here was first clarified by Cerni who shows it also to be a direct product of the CIT standardization challenge. Rapidly developing technologies tied to systems needs that include a substantial international interconnectivity component require action to set international standards before conflicts between incompatible national standards emerge. In Cerni's own words:

> "This approach makes the international body the primary standards writer. In this 'proactive' mode, the process is totally reversed: the international standard precedes the national standard."(4)

Cerni and Gray further characterize the proactive process:

> "This type of standard is developed along with new products, systems and services. This process involves tremendous planning with regard to systems that do not as yet exist and may not exist for some time."(5)

Cargill avoids use of the term proactive, but describes a situation not unlike that suggested by Cerni and Gray when defining his concept of *process* standard. Following from the

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3. Sullivan, p. 2.

4. Cerni, 1984, p. 107.

5. Cerni and Gray, pp. 49-50.

speed of technological development and the slowness of consensus standard-setting, Cargill proposes the process standard as a response to these pressures:

> "The process standard focuses on the transmutation of a customer need into a customer solution, examining a system's inputs and outputs but not concerning itself especially with the products that accompany the transmutation. In other words, it is concerned with the ends, not the means."(6)

Before proceeding to a discussion of the implications of proaction and related concepts, it is informative to put forward some views from among the standards participants themselves which introduce important contextual elements. Reflecting the context of Cerni's original identification of the proactive mode, an official of the ISO/IEC JTC 1 in Geneva remarked that in highly innovative areas, standardization must begin as a "modelling" activity, preferably at an international level. This means that in the initial stages the accepted "bottom up" approach - by which the standards process is instigated by discrete questions posed by potential "stakeholders" in the existence of a standard - is reversed.

A veteran of several ISO Open Systems Interconnection (OSI) standards committees defined proaction as the process of deciding ahead of time which parts of a technology need to be standardized; that the achievement of OSI was not the standards themselves but the fact that agreement was reached on the *framework* within which these and future standards would develop and function. Related directly to this, a prominent SWO official stressed the role of the user, suggesting that,

6. Cargill, p. 33.

in effect, proaction is a user strategy in dealing with systems requirements when faced with rapidly changing technologies and the threat of single firm domination because of the non-interoperability of installed equipment bases. Although such a user strategy can be demonstrated, the reader would do well to recall the unique problems in defining user perspectives which were outlined in Chapter Four.

In the view of a CIT consultant to the UK Department of Trade and Industry, proaction is defined more generally as a strategic response to pressures (especially international ones) that standardization occur. In this sense, proaction is the ordering and mobilization of national industrial objectives such that the standardization process is encouraged to yield results that fit with these objectives. Interestingly, it was this consultant's view that the *reactive* approach was the one most closely tied with the position that market forces alone would yield appropriate standards at appropriate times.

There have essentially been two institutional responses to the emergence of proactive thinking. The first is to pressure existing standards fora to respond with streamlined and accelerated procedures. JTC 1 itself is a result of these pressures. Alternatively, new SWOs with radical operating procedures may be formed. The European Telecommunications Standards Institute (ETSI) and the Open Software Foundation (OSF) are examples of this phenomenon and will be discussed further along. Significantly, in all cases there would appear to be an insistence that consensus principles of some description continue to be applied as far as absolutely possible.

In summary, the above preliminary exposition of the term "proactive" connects with the contention made earlier that CIT standards are primarily of the *performance* variety - ends directed. It would appear that proaction is less a directly oppositional element to established consensus processes than it is a response to some of the inadequacies of these processes when faced with a fluid technological and market environment. The idea of proaction reflects the speed of technical development, the resulting pressures on consensus fora for standards-setting, the internationalization of interests with the corresponding emphasis on systems, the need for coordination of standards into the industrial planning process, and the increased profile of the user with respect to all of the above. This said, the status of the concept remains highly controversial.

Two Positions

Essentially, the argument as to whether or not proactive standards are fact or fiction is predicated on the belief either that standards must always follow the implementation of a technology (position one), or that it is possible for them to precede implementation (position two). The matter is often put another way: are standards technology driven (position one) or needs driven (position two)?

By way of introduction to this dilemma, the inclination of one public sector executive with extensive experience in the development of open systems standards was to discount entirely the prospect that OSI was an anticipatory (ie proactive) move. His reasoning was perfectly sound: OSI was a user reaction to the market position of dominant equipment vendors, and based solely in *existing* technology. More significant, however, was his subsequent insistence that it was already identified user requirements and not anticipated ones which became the driving force behind OSI.

This latter conviction serves not to dispense with the proactive concept, however, but to suggest some new parameters. The prospect is not eliminated that it might be possible to use "proaction" as a term without necessarily referring to the unproven and the untried. Instead, reference can be to context as has been indicated above. Based on analysis of the perceptions of this activity as gained from documentary and interview sources it would appear that this contextual meaning is indeed dominant, albeit expressed in different ways.

Participant comments emphatically reinforce one or another concept of standardization in CIT as *part of a dialogue between technical innovation and user requirements*. The writer must conclude that polarization of needs and technology as generators of standards is largely spurious and based in a preoccupation with means over ends.

Legitimacy of the Term

It was maintained earlier that standards arise out of the common identification of problems in the belief that collectively formulated solutions will yield increased benefit to better than a majority of parties concerned. Cargill suggests, furthermore, that success in consensus development depends not on compromise but on *redefinition of the problem* such that a collective solution becomes possible.(7)

It would follow therefore that the question of whether a standard is set before or after deployment is dependent upon the nature of the service intended to be provided by the technology in question. If the case can be made that from the beginning stages the need for a standard is identifiable - if the service requirements cannot be met except on the assumption that a standard exists - then this recognition becomes tied to the application of the technology. If no such prior case can be made, it can only be left to experience of the product in actual use to determine if the need for a standard exists.

The position will be taken here that "proaction" be retained as a legitimate term in the standards discourse. This is for two reasons. First, the term is current even if variously and imprecisely defined as of this time. It is arguably more fruitful to offer a more consolidated definition for an existing term than to offer up a new one.

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7. Cargill, p. 32

Second, the term as it stands accurately describes an emerging phenomenon provided that the circumstances of its application are precisely described. As several of the engineers interviewed insisted, it is not really possible to standardize technology that does not yet exist. As phrased in one instance, "one cannot standardize one's research." However, the examples of standards initiatives usually characterized as being proactive are not tied to the invention of new technologies as inextricably as they are tied to the necessity in certain instances of providing suitable contexts for the use of these technologies. All that is necessary is for there to be a recognition that the technology cannot be implemented without the standard.

The definition of a proactive standard to be used from this point forward is that it is a standard developed in specific instances where the existence of a standard is concomitant with the application of a technology in the provision of a service. Taken this way, proaction does not refer as directly to matters of technical innovation as it does to planning and managerial functions.

The next task in this exploration of proaction is to somehow exemplify the phenomenon. Such major standards initiatives as OSI and ISDN have already been mentioned and these are often identified outright as examples of proaction. While the writer would concur in this assessment, these examples are highly complex. Not all standards in OSI and ISDN are new or even specifically developed for these initiatives. Moreover, some standards are shared between OSI and ISDN. Some are based on existing technologies with proven applications and others are as yet theoretical. In both cases, proaction can only be completely ascribed to the conceptual framework.

The characteristics of proactive standardization can be more cleanly drawn by examining smaller models drawn from specific standards. In this endeavour, two historical examples are offered in order to illustrate both the transformations which resulted in the proactive variant within the standards "culture," and the rationale and strategy necessary to instigate and sustain proactive initiatives.

Chapter 6

Transitional Concepts in Standards-Setting: The Case of X.25

In the early 1970s, the CCITT began to develop standards for the connection of data processing equipment to the public telecommunications networks. The series of recommendations produced for this purpose is known as the "X" series and now comprises over forty standards covering such matters as the basic definitions of classes of service, specifications and protocols for network interfaces, signaling rates, and message handling systems.

X.25 was adopted in its first version by the 1976 Plenary Assembly of the CCITT and specifies the protocols by which user equipment can be connected to public networks working in the packet-switched mode.(1) It is a significant standard in that its development process had to confront some of the fundamental "cultural" tensions existing between the telecommunications and the data processing industries with respect to standards. X.25 also exemplifies most of the elements listed in Chapter Five as generators of a proactive response to standards development. In order to understand how these elements apply in this case, however, a description of the technology involved is necessary.

Packet-Switched Networks

Packet-switching is conceptually an extension of the postal and telegraph service concepts, which is to say that

1. The standard was further revised after 1976 - the present version is that adopted by the November 1980 Plenary.

the system is activated as and when there is a block of information to be transmitted, with access allocated in exact proportion to the size of the information block. Although data transmission now amounts to a sizeable portion of their traffic, telecommunications systems remain largely geared to the transmission of voice messages. The primary characteristic of a traditional telephone system is that it sets up a situation akin to a face-to-face conversation and therefore necessitates the provision of a dedicated switched circuit for the duration of the message exchange, regardless of the continuity of the message involved.

The provision of dedicated switched circuits is somewhat antithetical to the communications requirements of contemporary information technologies which process data translated into digital form by means of binary codes. Data transmissions can be sent via a normal telephone circuit provided the information is first converted from digital to analog form (using a modulator-demodulator or "modem"). Alternatively, they can be sent via an exclusively digital network. In the latter case, as the nature of data transmission is usually sporadic rather than continuous, no dedicated switched circuit is necessary and the information can be transmitted piecemeal as required in the form of *packets*. The process is called "packet-switching," referring to the fact that network access and routing is granted independently for each packet.

The packet may take a number of forms, but the process is roughly comparable to mailing a document one or two pages at a time rather than in a consolidated form, and then being reassembled at the point of delivery. Each packet carries a digitally coded form of address, followed by a coded segment of the actual information being transmitted. It is then routed by means of algorithms operating at each connecting node in the network. Provisions are made for verifying that the total number of transmitted packets have been received, and for re-ordering lost or damaged packets from their source.

Packet-switching can make far more efficient use of the network where digital information exchange is concerned. Also, as Sirbu and Zwimpfer have noted, the point was eventually reached where packet-switching became more economical owing to the fact that the "cost of computer processing needed to create, process, and switch packets was declining at a much faster rate than that of communications channels."(2)

There are essentially two methods of packet-switching, depending on whether the packets are resequenced by the carrier network, or by the user's equipment at point of delivery. The former scenario is called a *Virtual Circuit* (VC) and is set up by an "addressing packet" which informs the network as to where subsequent packets are to be sent. The latter scenario is referred to as a *Datagram* - in this case

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2. M. A. Sirbu and L. E. Zwimpfer, "Standards Setting for Computer Communication: The Case of X.25," *IEEE Communications Magazine*, Vol. 23, No. 3, March 1985, p. 38.

each packet carries a complete address and may be routed through any available channel in any order. These distinctions played an important role in the X.25 development process - to an extent, the VC reflected many elements of the entrenched telecommunications culture whereas the Datagram reflected the more independent, "user-based" philosophy which had begun to emerge in computer applications.

Background to X.25

Packet-switched networks were originally proposed as secure decentralized communications networks for military applications, but the more general applications of this technology soon became evident. Between 1962 and 1968, packet systems were developed in the UK at the National Physical Laboratory and in the US through the Advanced Research Projects Agency (ARPA). The US initiative developed into ARPANET, a packet network using host computers situated at various academic and research institutions. By 1977, there were 111 hosts connected to ARPANET.(3)

The concept quickly moved into the public telecommunications networks. In 1972 the original private contractor for ARPANET went on to form Telenet Communications Corporation with the intention of providing a public packet-switched network in the US. Similar proposals followed in France (TRANSPAC, proposed by the French PTT), Canada

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3. L. G. Roberts, "The Evolution of Packet Switching," *Proceedings of the IEEE*, Vol. 66, No. 11, November 1978, p. 1308.

(DATAPAC, proposed by the Trans-Canada Telephone System), and Japan (supported by Nippon Telegraph and Telephone).

A Standard for the Packet-Switched Interface

As Roberts indicates, the necessity for worldwide interconnection protocols was evident from the beginning.(4) Problematically, however, the three principal supporters of the initial standards proposal at the CCITT - Canada, the US and France - could not agree on whether the standard should be based on the Virtual Circuit or the Datagram model.

Essentially, the controversy revolved around the level of control which would ultimately be held by the carriers and/or the service providers. As mentioned, the Datagram concept would place most of the control over the process at the level of the user's own equipment (referred to commonly as the Data Terminal Equipment or DTE). Bochmann and Goyer have noted distinct practical advantages with the Datagram in that it uses relatively simple technology and the service is easy to set up.(5) On the other hand, many of the technical and cost advantages often claimed for Datagrams are the subject of debate.

In the X.25 standards-setting context, however, national and corporate agendas are perhaps more significant than technical ones. The DATAPAC service proposed by the Trans-Canada Telephone System in 1974 was based largely on the

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4. Roberts, p. 1310.

5. G. V. Bochmann and P. Goyer, *Datagrams as a Public Packet-Switched Data Transmission Service* (Montreal: Univ. de Montréal, March 1977), pp. 13-16.

Datagram concept and TCTS was anxious to begin implementation. However, the Telenet proposal as submitted to the US Federal Communications Commission (FCC) in October of 1973 was conceived from the beginning as a VC service.(6) The US proposal recognized that the major part of the possible revenue from the service would flow from the provision of network services and not simply from the transmission of packets.(7) Most other proposed networks were also based on the VC approach.

Compounding this lack of primary agreement as to the basic technology, there was also lack of accord at the level of international representation once the standards question had been referred to the CCITT. The objectives of both TCTS-DATAPAC and Telenet were not without domestic opposition (from CNCP Communications and AT&T respectively) making the presentation of unified national positions very difficult.(8)

The decision to proceed in spite of these many obstacles was predicated on a single overriding condition. Regardless of which mode of operation was eventually chosen as the basis of the standard, it would ultimately be necessary for the computer sector itself to manufacture the necessary hardware and software in sufficient quantities and at competitive cost.

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6. Telenet Communications Corp., *Application for a Public Packet-Switched Data Communications Network*. Before the Federal Communications Commission, Washington, October 9, 1973.

7. Telenet Communications Corp., pp. 51-58. Sirbu and Zwimpfer, p. 39.

8. Sirbu and Zwimpfer, p. 39-40.

Without a standard of some kind, there would be no incentive for the computer firms to service the system. This would place the service providers in the impossible position of having to provide components specifically engineered to be compatible with all the different proprietary computer configurations and architectures. The provision of large scale packet-switching networks would flounder owing to the unavailability and/or unaffordability of the system components.

In January 1974 the packet interface question was referred to CCITT Study Group VII (SG VII). By February 1976 an agreement on a standard had been reached. The time scale - just over two years - was of a brevity virtually unknown in the international standards-setting arena. Cerni and Gray report that attendance levels at Special Rapporteur meetings in connection with the work of SG VII was on an unprecedented scale, and that considerable pressure was being brought to bear on the CCITT to come up with a Recommendation in the matter.(9) Significantly, the issue of VC versus Datagram was not resolved in the 1976 version; it was rather accommodated in the language of the standard so as to leave both possibilities open. Criticism of the obvious technical problem of the interconnection of networks operating in different modes led to further revisions. The November 1980 version of X.25 adopts VC as the basic paradigm while at the same time allowing for the "option" of Datagram-like services.

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9. Cerni and Gray, pp. 57-58.

This can hardly be considered surprising given that the CCITT is primarily an organization of telecommunications carriers. Sirbu makes a good case that regardless of the true cost/benefit position of the two approaches, the VC most closely approximates the accepted service and revenue generation methods of the telecommunications sector and was therefore the inevitable choice upon which to base the X.25 protocol.(10)

Implications Following From X.25

As most standards are the result of extensive negotiation, none can be said to embody "perfect" technical solutions. Cargill's insistence on problem redefinition as the basis of consensus rings true in this context. With X.25, Sirbu and Zwimpfer identify a definite shift in standards rationale from that of simple compatibility to that of variety reduction. A decreased emphasis on the need to consolidate existing markets, and the increased emphasis on the use of standards to create new ones has led in this case to the early promulgation of a standard which left many technical problems unaddressed.(11)

The ultimate test of success in standards work, nevertheless, is that the standard gets used and that the envisioned results are substantially evident. By these criteria, as Sirbu and Zwimpfer point out, X.25 is certainly a success - networks are operating and computer manufacturers

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10. Sirbu (1989), pp. 14-15.

11. Sirbu and Zwimpfer, p. 37.

have been successfully enticed into providing compatible equipment.(12) Furthermore, an important by-product of the implementation of X.25 has been to increase the interest of the telephone and computer companies in each other.(13)

Of great significance to the present discussion, there was recognition following publication of the 1976 version of X.25 of an important jurisdictional issue as between the responsibilities of the CCITT and those of the ISO. It was clear that the first version of the X.25 protocol affected several existing and developing ISO data processing standards. In November of 1976 it was the decision of the CCITT Informal Special Rapporteurs Meeting on Packet Mode Operation to proceed with the development of a further version of the protocol independently of the ISO.(14) However, this is more indicative of the pressures exerted to clarify the X.25 standard than it is an indication of any unwillingness on the parts of CCITT and ISO to cooperate. As Cerni has documented in some detail, a collaborative relationship has been working itself out between CCITT and ISO since the beginning of work on the Open Systems Interconnection.(15)

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12. Sirbu and Zwimpfer, p. 42. Also see G. A. Deaton Jr. and R. O Hippert Jr., "X.25 and Related Recommendations in IBM Products," *IBM Systems Journal*, Vol. 22, Nos. 1/2, 1983.

13. Cerni and Gray, p. 61.

14. Gregor V. Bochmann, *Final Report: Study of Standard Issues for Access Protocols of Public Data Networks* (Montreal: Univ. de Montréal, March 1977, pp. 4-5.

15. Cerni (1984), pp. 171-181.

In the opinion of many (including the present writer), the OSI reference model has become the archetype of the proactive approach. There are significant conceptual congruencies between X.25 and OSI. Furthermore, X.25 occupies a pivotal location in OSI. Sirbu and Zwimpfer note that the primary single feature of the X.25 standard which allowed its speedy promulgation in spite of the many technical problems and the concerns about the maturity of the technology involved was the adoption by the X.25 Study Group (SG VII) of a "layered" concept similar to the one being developed at the ISO for application to its open systems work.

> Recommendation X.25 separates the various network functions at the...interface into a physical layer, a link layer, and a packet layer. In theory, layering allows standards for each layer to be developed by separate working groups and is expected to facilitate changes to the standards as they evolve.(16)

"Layering" is a device by which equivalent functions in data communications are identified such that they can be made to interwork with each other by means of agreed communication conventions or "protocols." Moreover, the layers are situated heirarchically such that each is placed adjacent to the layer for which its particular function may provide some requisite basis for another form or level of service (see description of the OSI reference model in APPENDIX II). This concept enables a high degree of flexibility in applications, and it necessitates only that there be standards for the protocols by

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16. Sirbu and Zwimpfer, p. 43.

which equivalent levels communicate. Changes within the layers do not negate the effectiveness of the whole structure.

The development of the X.25 protocol was not the first occasion to suggest that the standards interests of data processing and data communications might be converging, but it was a significant and very high-profile occasion. As indicated in interview by a prominent researcher into computer communications, X.25 represented a conceptual switch at the CCITT from networks to architecture, and it began the development of a common vocabulary between IT and CT.

X.25 clearly reflects the definition offered above for a proactive standard in that it was developed in advance of service applications and in that the service in question would have been impossible without it. Significantly, X.25 does not deal in theoretical or unproven technology - many implementations of the various packet-switching technologies were extant. The significance of the proactive approach in this case is not that it was tied to implementation as such, but that it was tied specifically to the creation of a market for *public access* to packet-switched services. To do this, a standards initiative was activated in order to motivate the equipment suppliers and to secure the interest of the telecommunications sector. Out of the development process of X.25 and related standards, there began to emerge a "framework" concept in which the emphasis was placed on the strategic aspect of standards development in relation to the "life-cycle" of a technology in its market, rather than on the mere harmonization of specifications.

Chapter 7

A Complete Proactive Approach: The Example of the NAPLPS Videotex Standard

The X.25 case illustrates many of the rationales for engaging in standardization proactively. It also provides an insight as to the kind of changes likely to occur in the conceptual form of the standard itself. Proactive standards development is likely to display (1) a bias towards systems rather than components, (2) a "framework" approach allowing for options, sub-sets, and interpretations within general terms of reference, and (3) ample scope for tolerance of residual technical problems in the final standard. The emphasis has shifted away from the idea of the standard as a "frozen" specification subject only to periodic revision or deletion, and toward Green's concept of the "fundamental standard" in which there is inherent latitude for adaptation to the pace of developing technology.

A further characteristic of proactive standards is their propensity to become integrated directly into the research and development process. It has been noted that X.25 was concerned with providing standard access to *existing* types of services - which used already quite mature technology - in order that these services could expand into public networks. It is possible, however, for the proactive approach to be applied to technologies much earlier in their development stages. A well documented example of this phenomenon is the development of Videotex standards. The discussion to follow will concentrate attention on the North American role as illustrated by the development of the North American Presentation Level Protocol Syntax, or NAPLPS.

Some Technical Background to Videotex Systems

It has long been recognized that the possibility exists of using the television instrument for purposes other than the dissemination of traditional forms of broadcast programming. Although a broadcast application exists, Videotex is essentially an interactive or "two-way" concept encompassing a host computer and remote terminals located at the customer premises which are attached to conventional television screens.(1) Coded Videotex messages are transmitted back and forth over normal telephone lines. The visual displays are based on various methods of transforming coded data into graphic representations for text and pictorial material. It is the particular technology for achieving this display that forms the basis for the standards issue discussed in this chapter.

In the first phase of Videotex development it became clear that different and incompatible versions of the technology would develop. The first two serious contenders were the British PRESTEL system and the French ANTIOPE system.

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1. Videotex is often confused with Teletext, its broadcast cousin. The later is distinguished in that it is a "one-way" service which uses space on conventional television broadcast channels. There is sometimes further confusion in that the German term for Teletext is Videotext. The CCITT originally proposed "Videotex" as a generic term covering both "one-way" and "two-way" systems. It is now usually correct to assume that Teletext is considered to be a special application of Videotex. Teletext was, however, the first service to be developed and much of the display technology discussed in this chapter was originally applied to Teletext.

ANTIOPE and PRESTEL were similar in that they both used what has come to be called an "alpha-mosaic" technique in which regular-shaped blocks of pure colour were used to construct letters of the alphabet and pictorial graphics.

The standards question emerged in a debate over how the "attributes" - those codes used to control the graphic elements used in the display - would be dealt with by the terminal. PRESTEL used a "serial" approach in which both the attributes and the graphic elements were essentially stored in a common information pool which had roughly the capacity of the total number of such elements which could be displayed in graphic form on the television screen. The problem here was that each "attribute" and graphic element required the same amount of space in the terminal memory. This would often result poor image quality - for example, the memory spaces taken up by attributes showed up as blank spaces between blocks of differing colours.

Although PRESTEL underwent refinements to minimize this problem, the French developed an alternative storage method in which the attributes would be more-or-less "piggy-backed" onto the graphic elements. This approach resulted in blocks containing a greater number of information "bits" and requiring processing by a more advanced decoder having the memory capacity to store the attributes and the characters "in parallel." With the ANTIOPE approach, many display problems were eliminated.(2)

In spite of improvements, both systems retained a major disadvantage in that they were dependent on specific hardware. The "mosaic" approach meant that image resolution was dependent on the memory capacity of the receiving terminal. Any advances in terminal technology could only be accommodated by recoding the information in the data-bases already assembled by and for the previous generation of technology.

In December of 1978, the Communications Research Centre, a section of the Canadian Government Department of Communications, published a description of a Videotex system called TELIDON which was based on a radically new method of image description that would substantially overcome the display and flexibility problems inherent in PRESTEL and ANTIOPE.(3) TELIDON introduced a device called the Picture Description Instruction (PDI) which defines graphic images in terms not of mosaic constructions but in terms of basic geometric shapes.

Defined in this way, the image data is transportable (not bound to one set of hardware) and it can be upgraded and downgraded according to the resolution capabilities of the display equipment. It is also possible to transfer the data processed on older generations of equipment to newer equipment, and *vice versa*. As TELIDON could define a

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2. For a more thorough discussion of the serial/parallel problem and the links between the Teletext and Videotext technologies, see R. H. Veith, *Television's Teletext* (New York: North-Holland, 1983), pp. 81-91.

3. H. G. Bown and C. D. O'Brien et al, *A General Description of Telidon: A Canadian Proposal for Videotex Systems. CRC Technical Note No. 697-E* (Ottawa: Dept. of Communications, Dec. 1978).

virtually unlimited range of alphabet character sets as well as graphic images, the technology was termed "alpha-geometric." As PDIs could also be used to describe photographic-like images (in a similar fashion to "bit mapping"), those terminals equipped to display such images could be termed "alpha-photographic" terminals.(4)

The Videotex Standards Battle

The ultimate problem with TELIDON vis-a-vis the French and British systems was the need for specialized terminals capable of deciphering the PDIs. By the time TELIDON came on the international scene in 1978, many applications of ANTIOPE and PRESTEL (particularly PRESTEL) were already in operation or being planned. However, the much superior imaging available with the alpha-geometric approach created great interest among several major telecommunications and broadcasting companies.

A prime objective became to establish the TELIDON technology as the basis of an international Videotex standard.(5) The basic geometric imaging technology had been developed at the CRC well in advance of the presentation of PRESTEL at the CCITT in May 1978. Madden situates the formal beginnings of this work in 1973 with the formation of a CRC research unit to examine the problems of transmitting images

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4. Bown and O'Brien (1978), pp. 1-2, 6-7.

5. Canada, Dept. of Communications, *Telidon and the Standard-setting Process: Background Study No. 2 for an Evaluation of Telidon*, DOC Programme Evaluation prepared by TEEGA Research Consultants Inc. (Ottawa: DOC, March 25, 1985), p. 33. Referred to hereafter as_"Canada, DOC (1985)."

over normal telephone circuits.(6) The development of PRESTEL spurred an interest in the Videotex concept at the CRC and it soon became evident that they already possessed a technology that was in many ways superior for this purpose. A prototype was quickly assembled and the TELIDON system was announced publicly in Canada in August 1978.(7)

TELIDON was first introduced to the international community at the October 1978 CCITT meeting on Videotex held in Paris. According to an interview with a senior CRC official who was present at this meeting, the initial objective of the Canadian delegation was merely to observe the proceedings. However, in this official's view, it became obvious to the delegates that the standards discussions were by that time well enough advanced that to wait any longer before injecting the alpha-geometric technology would endanger its chances of being considered as a world standard and put in jeopardy any chances for the development of an industrial base around TELIDON. As with X.25, the rationale was to stimulate industrial sectors to provide and service relevant products.

The essential point to grasp at this juncture is that, unlike the situation with X.25, development of the Videotex standard amounted to much the same thing as development of the technology. It must be stressed here, that there was little

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6. John C. Madden, *Videotex in Canada* (Ottawa: Minister of Supply and Services, 1979), p.20. However, the beginnings of interactive video systems research at the CRC has been placed as early as 1969; see Canada, DOC (1985), p. 33 n.

7. Madden (1079), p. 21.

more than a laboratory model of the TELIDON system in existence at this time; the Canadian program had been primarily research orientated and applications experience was very limited. The official "TELIDON Program" announced by the DOC in April 1979 was a four-year project aimed towards the aggressive promotion of the production and consumption of TELIDON related goods and services, and all of this was transparently connected to the pivotal concern of influencing the standards-setting process in favour of the TELIDON technology.(8)

The recollection of the informant just cited would tend to reinforce the link between the standards question and the decision at DOC to increase the profile of TELIDON through a government supported industrial development program. The informant recalled that following the Paris meeting there was initial concern within the DOC that the TELIDON technology had been exposed at too early a stage in its development cycle. It was soon recognized, however, that further development was dependent on the probability of markets, and that markets would only follow should TELIDON be accepted as an international standard.

Subsequent to the 1978 Paris meeting, further details of the TELIDON system were presented and certain strategic alliances began to form.(9) Canada and France agreed to do

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8. Madden (1979), pp. 24-26. Canada, DOC (1985), p. 33.

9. TELIDON was described to the CCITT in terms of the CRC Technical Note 699.

cooperative research, chiefly concerning the issue of character sets (Canada's bilingual requirements proving a strategic asset here).(10) During this time AT&T in the US had also begun to construct a system based substantially on TELIDON, and the Japanese, with obvious concern for character set issues, were attracted to the "alpha-photographic" possibilities of the Canadian technology. The Europeans had also made alliances with the Americans and systems trials were initiated at various places in the US. It became necessary for the Canadian effort to be focused simultaneously on the North American and International arenas.(11)

In October 1980, the CCITT adopted its first set of Videotex Recommendations (S.100 and F.300). Two significant similarities with the X.25 process are observable. First is the brief time period (less than two years), and second is the relatively unsatisfactory nature of the Recommendations when viewed from a purely technical perspective. S.100 and F.300 did not choose between the mosaic and geometric technologies but rather gave them equal status as international standards.(12) Many technical problems remained: the

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10. "Canada and France sign research agreement on Videotex," *Telecommunication Journal*, Vol. 47, Jan. 1980, p. 37.

11. M. J. Nyhan *et al*, "Videotex and Teletext in the US: Prospects for the 1980s," *Telecommunication Journal*, Vol. 47, June 1980, pp. 396-400. The first test of a fully transactional Videotex system in the US was by the First Bank System Inc. in 1982. It used ANTIOPE technology in the version known as Télétel; see "Fully transactional videotex system trial," *Telecommunication Journal*, Vol. 49, Jan., 1982, p. 45. For more detail on the North American strategy of the TELIDON Program, see Canada, DOC (1985), pp. 48-50.

"serial/parallel" issue was not resolved, and the problem of integration of the mosaic, geometric, and photographic schemes was not touched.(13) Nevertheless, the Recommendations were enough to engender sufficient confidence for at least the development of regional markets for Videotex. Some of the residual problems between the two European systems were eventually worked out at the European Council of Post and Telecommunications Administrations (CEPT). In the meantime, the TELIDON Program focussed much of its attention on its potential US allies.

NAPLPS: A Second Generation Videotex Standard

Lum refers to the events just outlined as the first phase of standards production for Videotex. The second phase, he sees as stemming from the May 1981 Videotex Conference held in Toronto at which the CEPT T/CD 6-1 Videotex Standard was announced, and also the Bell System Videotex Standard Presentation Level Protocol (PLP).(14) The PLP was essentially the original TELIDON technology with a number of graphical enhancements and a unified coding syntax so as to integrate the system more fully within the "layered" Open Systems Interconnection architectural model being developed at

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12. The version of the Canadian technology referenced in the CCITT Recommendations is that detailed in CRC Technical Note 699, November 1979.

13. Canada, DOC (1985), pp, 34-36. S.100 and F.300 also standardized Dynamically Redefinable Character Sets (DRCS), allowing the processing of new character sets. DRCS does not constitute a complete coding system as does TELIDON, PRESTEL, and ANTIOPE, but is rather applied supplementarily.

14. Y. F. Lum, "Videotex Standards: A World Perspective," *Videotex Canada*, Spring, 1984, p. 38.

the ISO.(15) The TELIDON technology would fit into the Presentation Level of OSI.

This latter development resulted directly from technical cooperation between Canada and AT&T following the appearance of the 1980 Recommendations and in February 1982 an augmented description of TELIDON which was equivalent to the Bell system was forthcoming in the form of CRC Technical Note 709.(16) During this period, the Canada/US collaboration on technical development was reinforced with an equivalent standards initiative carried out between the American National Standards Institute (ANSI) and the Canadian Standards Association (CSA). In September 1983 the first version of the joint ANSI-CSA NAPLPS Standard was published and the standard was promulgated in December of the same year.(17)

Previous to the publication of this standard, however, the US had already injected the Bell PLP into the still evolving standards work at the CCITT (in August 1982). This

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15. C. D. O'Brien and H. G. Bown. *Telidon - Videotex Presentation Level Protocol: Augmented Picture Description Instructions. CRC Technical Note 709-E*, (Ottawa: DOC, Feb. 1982) p. 7. See also M. Sablatash and R. Fitzgerald, *Design Methodology and development History of an ISO Layered Architecture for the Canadian Broadcast Telidon System. CRC Technical Note 708-E* (Ottawa: DOC, August, 1981).

16. As stated in Canada, DOC (1985), p. 37: "The Bell System PLP was quickly endorsed by Canada since it had evolved out of technical discussions carried out ... between Canadian and ATT officials... AT&T developed this document in close collaboration with the Canadian team that had developed Technical Note 699 and that was working on an augmentation of these specifications."

17. The official title of the standard is *Videotex/Teletext Presentation Level Protocol Syntax - North American PLPS*. It is listed in the CSA catalogue as CSA T500-1982, and in the ANSI catalogue as ANSI BSR X3.110-1983.

action prepared the ground for submission of the finished NAPLPS standard. In the meantime, the Japanese had developed a Videotex system of their own called CAPTAIN and presented it to the CCITT. In dealing with this second phase of technology with its accompanying standards alliances, the CCITT At its VIIIth Plenary Assembly in October of 1984 substantially repeated its 1980 action of providing for three options. Recommendation T.101 specified CEPT, NAPLPS, and CAPTAIN as the acceptable choices for a Videotex standard. The debate continues.

NAPLPS as a Demonstration of the Nature of Proaction

To varying extents, NAPLPS represents all of the rationales and features identified in connection with proactive standardization. Its beginnings were in the realization that services were impossible without the prior adoption of a standard and that the market potential of those services was ultimately dependent on the proliferation of that standard. The international dimension and the systems emphasis are clear. The roles of the user and supplier communities are as yet oblique, but present nonetheless - the NAPLPS process was carried out primarily at the engineering level but with the expectation that the resulting technical environment would foster user demand and supplier incentive. It must be remembered that in the crucial (for Videotex) 1978-80 period, marketing concepts were only beginning to emerge in the telecommunications sector, and computing was still largely mainframe oriented with a comparatively limited range of users.

Most importantly, NAPLPS illustrates well the two aspects of the proactive approach which have potential to substantially alter the ways in which standards-setting in general is perceived. First, it is indicative of the pressure which can be brought to bear on traditional avenues of standards-setting as unstable technologies are pushed headlong into the service realm. In this case, the pressure appeared openly at the international level - arguably the most important level. Although the above narrative is focused around NAPLPS, it should be taken into consideration that the CEPT and CAPTAIN proposals as well as the first incarnation of the Bell PLP were also essentially proactive initiatives. Furthermore, they were carried out concurrently at the regional and international levels. Each of these individual standards and both the 1980 and 1984 CCITT Recommendations were brought forward in time frames of roughly two years. In two successive attempts the international standards system could not respond effectively so as to integrate the competing approaches into a unified standard. It must be emphasized that a choice between PRESTEL and ANTIOPE as an international standard was at the verge of being made at the very point that the TELIDON technology appeared.

Second, the NAPLPS case shows how consideration of the standards issues is moving from the rear of the industrial process and into its vanguard. In this instance, the standards and the technology were developed at one and the same time. They were also championed at corporate and governmental levels, and tied directly into business strategy.

A final aspect points to a significant problem in that acting proactively can result in standards which are out of step with their intended applications. Seen purely as a standards initiative, even taking into account the less than satisfactory state of the eventual CCITT Recommendations, NAPLPS was a resounding success. The TELIDON technology was transformed from a last-minute entry into an equal standards option in a remarkably short time. On the service side, however, Videotex in general has made a poor showing, its promise to a large extent usurped by the emergence of personal computers. Although NAPLPS has been fortunate in that it has "found other work" in the computing sector, its example should stand as a warning that ultimate success for a proactive standard is likely to depend less on its technical merit, and more on the degree to which the technology to which it refers is fitted to accurate assessments of the market potential of its application profiles.

Chapter 8

Proaction and Participation I: CIT and the Changing Nature of Standardization

Reddy has suggested that product standards are a method by which sectoral interdependencies are institutionalized, both formally and informally, in the process of market planning.(1) This view is centered in a species of marketing theory which has a base in political economy rather than strict instrumentality, and the characteristics of proaction would tend to support this leaning. In Reddy's own words:

> "In an environment where change is ever present the effectiveness of an industrial marketer may in large part be determined by the conscious attention paid to managing such interorganizational, interindustry interdependencies."(2)

Moreover, Reddy points to a key feature of such interdependencies when faced with new technologies, namely, the process of creating a common language whereby the product may be explained to the market.(3) Standards, particularly proactive ones, play an important role in this informational function.

In identifying these links between innovation, business strategy, and proactive standards development in CIT, the question is posed as to the extent to which the standards-

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1. Reddy (1985), pp. 24-63.

2. *Ibid*, p. 30.

3. *Ibid*, p. 43-46.

writing system has responded with new working arrangements reflecting these connections.

Institutional Response to Proaction

Over the past ten years, significant shifts in emphasis and operational procedures can be observed in various standards developing bodies worldwide. Perhaps most noteworthy - from a symbolic as well as functional perspective - was the creation late in 1987 of the IEC/ISO Joint Technical Committee 1.

JTC 1 was formed out of the ISO Technical Committee 97 (information technology - dating from the early 1970s) and two IEC technical committees dealing with computing hardware. Differences in ISO and IEC operating procedures have been rationalized and a "fast-track" option introduced.(4) Significantly, this rationalization has been biased towards existing IEC procedures which reflect the fact that, historically, IEC membership has been restricted to countries possessing the capability to actually participate in standards development.(5) By contrast, ISO membership can be on an "observer" as well as a "participant" basis (with the result that most of the world's countries are members of ISO). While the IEC has agreed to introduce "observer" status within JTC 1, ISO has agreed to adopt IEC committee rules which allow for

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4. From from interviews at the ISO/IEC it was learned that the fully integrated procedures will go into effect in January of 1990.

5. IEC, *Statutes and Rules of Procedure, 1974 - Incorporating amendments approved up to the end of 1986* (Geneva: IEC, May 1987), page 7, Article 4.

consensus to be determined largely at the discretion of the committee chairman. The JTC 1 "fast-track" allows existing standards to enter the process as Draft Proposals (thus by-passing the formal preliminary question stage) and to be dealt with by JTC 1 sub-committees directly as Draft International Standards.

In cases where no consensus is seen to be forthcoming from a JTC 1 sub-committee, a further available mechanism of influence is the issuing of committee findings in the form of Technical Reports. Although these reports have no force as standards, in the view of one JTC 1 official they can perform an important function of a standard in that they can help to stabilize the technical discussion.

Pressures at the ITU for the consolidation of the CCIs have already been mentioned. Interviews with senior officials in the CCIR and the CCITT confirmed that irrespective of the provenance of recent amalgamation proposals, and of jurisdictional issues between the CCIs themselves, consolidation of standards related work in some form more logically reflects the momentum of technical developments.

Nonetheless, in the present absence of such consolidation, certain measures have been installed with the twin aims of keeping pace with standards requirements and maintaining effective synchronization with other agencies such as JTC 1. The CCIs remain substantially bound to a three to four year working period (or plenary session). In order that pressing standards issues can be resolved within shorted time frames, the practice of assigning Interim Working Parties to problem areas has been employed. Most recently, however, the Plenipotentiary Conference (Nice, June 1989) affirmed that special powers were to be given to CCI Study Groups to refer Draft Recommendations upon which there is unanimous agreement directly to the membership for approval.(6) Although documentation of this process was not completely available at the time of writing, consultation with ITU officials indicates that if within three months 70% of the replies received are supportive, the Recommendation is approved and published.

Coordination between JTC 1 and the CCITT has also been given a higher profile. There is now a Collaborative Group on Procedures which has the task of explicating for purposes of integration, the various operations of the two entities. The emphasis is on forward planning.(7)

ITU and ISO/IEC responses are still in a development phase. However, there are alternative approaches from several perspectives. There is also the possibility of nationally coordinated action with the aim of proactive control over standards-setting processes, irrespective of the forum.

Reworking the Consensus Ideal

In March of 1988, the European Council of Post and Telecommunications Administrations (CEPT) officially

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6. ITU, *Final Acts of the Plenipotentiary Conference, Nice 1989* (Nice: June 30, 1989), Convention Article 21, Secs. 224A, 226, 227, pp. (B) 30-31.

7. IEC, ISO, and CCITT, *Informal Guide for ISO/IEC JTC 1 and CCITT Cooperation*, (n. p.: the Collaborative Committee on Procedures for JTC 1 and CCITT Cooperation, July 1988. pp. 16-22.

inaugurated the European Telecommunications Standardization Institute (ETSI) and devolved all of its standards-setting responsibilities to this new organization. Pressure to take this action was forthcoming from the Commission of the European Communities in the wake of its publication of a 1987 Green Paper on telecommunications development.(8) The Green Paper was in itself a response to calls for full harmonization of trade regulations and standards contained in the 1986 *Single European Act* which specified the creation of a continental free trade area among the EEC countries by 1992.(9) The proactive context in this instance was defined by an official public policy objective to remove possible technical barriers to trans-border information flows and to encourage competition in the telecommunications sector.(10)

ETSI is an altogether different breed of standards writer. Structurally, the only real congruencies with existing practice is that the hierarchical committee system and the principle of national voting are retained. ETSI is made up of (1) a General Assembly to approve general administrative affairs, (2) a Technical Assembly to supervise the standards preparation, (3) a Secretariat for day-to-day administration (4) Technical Committees to carry out the

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8. Commission of the European Communities, *Towards A Dynamic European Economy: Green Paper on the Development of the Common Market for Telecommunications Services and Equipment* (Brussels: EC, 30 June, 1987), pp. 98-113.

9. W. A. McCrum, "A Summary of the New European Community Approach to Standards Development," Dept, of Communications mimeo, ca. 1988, p. 2-4.

10. ETSI, *Annual Report 1988*, (Nice: 31 March 1989), pp. 1-2.

actual standards work, and (5) Project Teams. It is significant that the Technical Assembly is the highest authority in ETSI. It decides the work program, allocates the funds, and assembles the Committees and Project Teams.(11) Three primary objectives were specified for ETSI.

> "- Firstly the standardization should be made more quickly than hitherto in order to get substantial results before 1992.
>
> - Secondly the principle of consensus, which had hitherto been governing, should be replaced by the principle of weighted voting...
>
> - Thirdly the participants should not only be the PTTs but also the industry, the public network operators, the users including private service providers and also research bodies."(12)

In meeting the first objective, the Project Team concept plays a leading part and in the process substantially redefines the nature of standards committee participation. Project Team members are not "volunteers" in the traditional sense - they are rather selected assemblies of experts paid to work out specific technical standards problems within a rigidly specified time. Remuneration of Project Team members comes directly from ETSI and is on a full-time basis.(13) Moreover, project teams are expected to work together in the same location (ETSI plans to maintain its own research facility at its headquarters in Nice).

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11. Ib Lonberg, "ETSI - The European Telecommunications Standards Institute, *Teleteknik*, No. 2, 1988, pp. 70.

12. ETSI, *Annual Report 1988*, p. 2.

13. Lonberg, p. 70-71.

With respect to the second objective, it must be conceded that the use of weighted voting is considered by the ETSI delegates interviewed as being an instrument of last resort.(14) This is indicative of the continued acceptance of the consensus ideal. Nevertheless, the fact that an overriding mechanism is present in the ETSI structure is an indication that the requirement for expedited acceptance or termination of a standardization initiative is beginning to take precedence over concerns about the consensual nature of the decision process.

A more radical alternative still, is that of the Open Software Foundation (OSF), a consortium set up in 1988 among several major computer companies in response to a perceived competitive threat from a corporate alliance between AT&T and Sun Microsystems with respect to the marketing of AT&Ts UNIX portable computer operating system.(15) Saloner indicates that although the stated aim of OSF is to promote a "common applications environment" based on the UNIX concept, the group is firmly in the control of the sponsor companies.(16)

Saloner lists two characteristics of the OSF approach to standards-setting. Firstly, OSF will produce standards in the form of a code which will be *licensed* to users. Secondly, OSF

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14. According to one official at the European Commission in Brussels, there has been only one instance to date of the voting option being used.

15. Original members of the consortium were IBM, DEC, Hewlett-Packard, Apollo, Siemens (W. Ger.), Nixdorf (W. Ger.), and Bull (France).

16. Garth Saloner, "Economic Issues in Computer Interface Standardization," unpublished paper, Feb. 1989, pp. 3-4.

will abandon consensus ideals altogether and merely call for tenders from among the pool of proprietary technologies.(17) Saloner's main interest in OSF is the potential economic influence of such a radical approach to standards establishment. In the context of the present work it is worth harkening back to the assertion in Chapter Five that *de facto* standards are often the best technical choices. The OSF approach is essentially the organized, intercorporate selection of openly proprietary technologies which are then presented to the market as candidate standards, the extent of use determining their legitimacy. Given the strategic market orientation surrounding much proactive thinking, this approach might well find acceptance in some quarters.

Functional Standards: a Possible Defining Role for the User

A feature of the organization of JTC 1 is the existence of a Special Group on Functional Standardization. The reference model approach exemplified by such developments as OSI often provide for a wide choice of standards selection, and allows for many "versions" and "sub-sets" of individual standards. Functional standardization can be roughly described as the process of choosing from among available standards in a reference model such that a functional profile directed at a specific application is identified. The process is a quasi second-level standardization process in which,

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17. *Ibid*, pp. 30-31.

importantly, the identified needs of particular users are foremost.

In addition to the JTC 1 Special Group, several other organizations are concerned with developing functional profiles. COS and SPAG have already been introduced in connection with OSI user interests. SPAG is a particularly valuable example of the increased role of functional profiles in that it has evolved into this arena. An interview with a senior SPAG official revealed that its genesis had no connection to OSI; that it was originally an *ad hoc* group attached to an EEC IT development project called ESPRIT. The original goal was to take standards developed in ESPRIT and to shepherd them into the international arena. Responding to the gathering momentum of OSI, SPAG moved into the role of "intercept" strategist - attempting to determine what the final standards might be so that European industry might respond with early products.

The interview revealed further that SPAG identified three options: (1) develop base standards, (2) "detail" base standards into functional profiles, and (3) engage in market development. The latter two options led SPAG into a role as a compiler of user guides to standards and as an OSI conformance testing agency.

The selection of functional profiles could well be the only stage of the standardization process with scope for participation by virtually all types of user. Furthermore, the applications perspective is the clearest definer of user interest. The problem, obviously, is that user interest in the standard - depending of course on how the user is defined - could well lie further up the process chain. As the SPAG official pointed out, the OSI standards were brought to the user by the supplier and, moreover, production of the SPAG standards guides was only possible because participation in their preparation was restricted to working experts.

The DISC Project: an Example of National Proactive Strategy

In the UK, plans are presently underway for the implementation early in 1990 of an industrywide nationally coordinated strategy for the direction and implementation of standards work in the CIT sector. The program is called Project DISC (for Delivery of Information Solutions to Customers) and the following exposition of it is drawn from interviews with officials and consultants at the Department of Trade and Industry (DTI) and the British Standards Institution (BSI).(18)

In the early 1980s, the DTI established a Focus Committee on Information Technology. In 1987, following a recognition of the centrality of standards issues, the Focus Committee initiated a joint effort between DTI and BSI to report on the standards-setting environment and to work out a basis for concerted response.(19) Most significantly in the present

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18. These discussions took place in London between October 16 and 19, 1989. At this time, preparation of the operational documentation for the DISC Project was in the final production phase but not yet publicly available.

context, a proactive motive was identified by the Focus Committee from the very beginning. The aim was to direct the standards-setting process in ways which would yield advantage to the UK industrial profile in CIT. It should be noted that the DTI/BSI report presented in February of 1989 was explicit in recognizing the long-term implications of the convergence phenomenon.(20)

The UK is noteworthy as the source for a program like DISC. Britain has a very high penetration rate of computing technology, and it also currently has the only telecommunications system in the EEC which has elements of private ownership and an operational degree of competition.

Briefly outlined, the characteristics and directions of DISC are as follows. The project is located within the BSI structure with additional ties to the DTI, thus lending it the legitimacy of the recognized national standards body and ensuring access to all the international fora.(21) The DISC technical forum is accompanied by a strategy setting forum which will seek to bring about a coordination of supplier and user interests. The eventual goal is to marry technical and

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19. The report *Information Technology Standardization* by Julian Bogod (*Op. Cit.*) was the result of this initial phase. Bogod is an IT strategist seconded from industry to the BSI for the purpose of laying the groundwork for what was to become the DISC Project.

20. "There seems little prospect of the barriers between IT and telecommunications standardization being broken down in the near to medium term but, in the interests of improved IT performance, this must be a clear objective for all concerned." Bogod, p. 9.

21. BSI is the UK representative at ISO/IEC. DTI represents the UK at the ITU and at ETSI.

commercial matters in the formulation of strategies to address the evolving European and world markets for CIT.

Funding of DISC is to be via membership fees, fees for participation in specific initiatives, and the marketing of the finished standards. Membership is open to individual firms, government departments, and industrial associations including user groups on an equal subscription basis. Fees are to be set at levels so as to encourage membership by small entities.

The decision making process is to retain the consensus principle. However, the DISC Project officials interviewed were prepared to accept an "evolution" of this principle should it be necessary in response to future pressures.

Summary of Pressures and Changes

Most of the environmental alterations listed above hinge on the requirement to speed up the standardization process. This is only partly a response to concerns about the costs of sustained standards activity, and predominantly a response to the increasingly strategic role that standards play in CIT. The general consensus among interviewees is that there is no shortage of available funds for the development of CIT standards; that on the contrary, the resources allocated to standards in this area are on a scale unprecedented in any other kind of standards work. Although precise figures were not forthcoming, JTC 1, for example, was described to the writer by ISO/IEC officials as having the largest budget and heaviest work load of any ISO or IEC undertaking. Officials also concurred in their estimates that the total portion of JTC 1 work is between thirty and forty percent of all ISO/IEC activity.

Proactive standardization is concerned with directing a process towards anticipated ends and to accomplish this most economically, the effort must be directed towards the higher levels of decision making. Speed of standards development results in greater flexibility for standards stakeholders to deal with products having short market cycles. As the X.25 and NAPLPS examples demonstrate, past effectiveness for proactive strategy has often required pressing for quick results even if it meant settling for less than ideal technical decisions.

There is now ample evidence that many organizations are prepared to reconcile their procedures to this proactive requirement. Alternatively, new organizational models are developing which may compete with the established players for CIT standards "business," with a view not only towards expediency, but also towards technical quality. Profound implications for the range of inputs traditionally associated with standards development may well ensue.

Chapter 9

Proaction and Participation II: General Summary

In the past, monopoly service providers in communications and disproportionately large individual firms in information technology were in positions to actually determine service requirements and dominant technical specifications. This is no longer true to the same extent. Technologies and expertise have proliferated and dispersed, and the old "centralized" economic models in these sectors are evaporating quickly. Proactive standardization is a concept to have emerged out of this new environment and in recognition of the fact that among diverse interest communities, standardization and product development are now intersecting concerns.

As the system responds to these changes, there will inevitably be changes in the nature of the input which fuels the process. It has already been noted, for instance, that the ideal of consensus is under some pressure. The difficulty of defining the user, let alone the "user interest" has also been discussed. Might redefinition of consensus also lead to reduction in the number of interest sectors contributing to the process (either invited or required under SWO rules), or to alterations in the relative influence of particular sectors? If it is yet too early in the day to give conclusive answers to questions like these, it is nevertheless possible to identify definite trends in the nature of participation in

CIT standards-setting, and to highlight potential difficulties.

Cargill has given an effective summary of the basic emergent changes to organizational structure and emphasis, and this provides a useful "baseline" for the present examination of participatory matters. Firstly, among all interest groups there will be a shift in emphasis towards international standards. Secondly, there will be less scope for input other than at the level of nationally coordinated and agreed positions. Thirdly, planning of standards will continue to out-run the decision making process. Finally, there will be major changes in standards organizations to reflect the business planning function of standards.(1)

The changing profile of the individual standards writer is both a significant occurrence in itself, and an indicator of fundamental changes in standards practice. Cerni was the first writer to comment at length upon the optimal characteristics of the actual standards writer.(2) In her discussion, the position of the part-time volunteer was contrasted with that of the full-time standards professional. Interestingly, of the 20 professional characteristics for standards writers noted by Cerni, only three or four relate to technical acumen. The majority relate to such things as political and cultural understanding, management and

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1. Cargill, pp. 120-21.

2. Cerni (1984) pp. 190-195.

communication abilities, and awareness of the international business milieu.(3)

Cargill goes to the length of insisting that a whole new profile for the standards-writer must emerge if the current goals for CIT standardization are to be achievable. The results of the present study largely support this contention. One of the most important things to come out of the interviews, and to some extent the documentary research, was that standardization in CIT is now perceived as an "element of business" which must be delegated or otherwise intimately connected to the executive function within an enterprise. Likewise, there is at least some evidence that the place of standards in CIT industrial strategy is beginning to be reflected within the standards development bodies and in government policies. It should be recalled that the DISC Project employed strategists and consultants seconded from industry to the DTI and the BSI. Cargill's somewhat turgid "technical engineering/business manager" appellation is nonetheless an apt description of the function which is quickly evolving for the CIT standards-writer.(4)

Nevertheless, the example of the ETSI Technical Assembly and Project Team structure would indicate that there is an additional possibility that the management and technical functions may continue to be bifurcated to some extent - the strategic matters may be decided at one forum, leaving it to

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3. *Ibid*, p. 195.

4. Cargill, pp. 87-98, 116.

another to work out the technical details. This would leave open the scenario of the emergence of some form of bi-level professional structure.

A note of caution should be sounded in all of this. Cerni identifies a danger in entrusting standards work to full-time professionals - an increased likelihood that they may loose sight of the practical objectives.(5) A further danger with regard to the participatory status of stakeholders is that there will probably be wide discrepancies in the abilities of individual entities to employ the kind of career professionals described above. This may well be a contributing factor to any increased reliance on national positions and strategies, contingent, of course, on the provision of some mechanism to guarantee access for all stakeholders to any such national consolidation process. The insistence by the UK DISC Project that participation by small firms be facilitated by low subscription fees is noteworthy in this respect.

An important point to emphasize is that contributions to CIT standards-setting originate primarily in institutional settings - corporations, governments, and industrial associations. Corresponding to the difficulty of accurately locating user and consumer perspectives, so also is it difficult to organize these perspectives into effective institutional configurations so as to effectively influence the standardization process.

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5. Cerni, p. 191-2.

In the opinion of many of those interviewed, the existing SWO structure is not in a strong position to respond to many of these challenges. Most national standards systems are dependent to a large extent on government subsidy which is chronically at low levels. Competent staff is difficult to attract and keep as corporate salaries cannot often be matched. Many areas of potential conflict between existing organizations have also been brought to light in the above pages, with most of these arising from a lack of clear demarcation criteria amidst converging technologies.

All of these stresses presently being exerted upon the existing standards organizations could well result in their eventual inability to cope. The possibility has never been excluded, and is now more likely than ever, that new standards bodies will spring up in response to such an exigency, or even by way of offering a direct challenge to the existing system - as with the OSF.

Amongst the standards operatives interviewed who were not employed directly by SWOs, there emerged no observable patterns of loyalty or attachment to particular existing standards fora, and several opinions were to the effect that the existing organizations should be watching their backs. The further possibility exists, according to one informant, that fast responding national and regional SWOs might effectively circumvent much of the actual discussion and development processes at places like the CCITT and ISO. Using the new "fast-track" procedures at the ISO/IEC and ITU, there is now greater likelihood that national and regional standards could become international ones with much less input and discussion, thus relegating the international bodies to a mere approval function.

A serious problem exists here concerning the matter of participation by developing countries, particularly in the telecommunications sector. The ITU has maintained an active "development" program, thus identifying the third world as a major source of new markets for communications equipment. Most developing countries possess neither the monetary nor the technical resources to participate in standards work other than as members of the major international bodies. Effective devolution of influence over international standards from the ITU to new "purpose-built" SWOs, or to national and regional strategic programs - especially from the functional perspective - could all but eliminate any chance that specific concerns from the developing world would be heard.

A challenge to all participants is issued in the form of the *de facto* adoption of the English language as the working language of CIT standards. This situation applies fairly generally across the spectrum of standards work, but the proactive approach leaves even less room for concessions to various linguistic sectors. ETSI, for example, although it publishes the finalized standards in English, French, and German, uses only English in its working processes.(6) Language problems are often cited as an impediment in

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6. Lonberg, p. 71.

conjunction with participation by the Asian economic sector, particularly Japan. However, an interview with a French SWO official yielded the candid admission that traditional reluctance to use other than the mother tongue is now recognized in France as a distinct impediment to French influence in international CIT standardization.

Conclusions and Future Implications

The proactive mode of standards practice has come about as the result of an increasing concomitance of supplier and user interests with respect to managing the applications of highly dynamic technologies. The concept is strategic and has emerged substantially out of the nature of the relationship between technology and its applications which exists in the CIT sector. Communications networks and data processing systems are infrastructural tools, which is to say that applications are not based upon utilization of the entire capacity of the tool, but rather upon selective functions aimed towards specific ends.

Several comparisons with reactive standardization are possible. Although it has been noted that there is a link between reactive standards and the view that market relations alone should generate standards, the prevailing opinion is that reaction is adequate only to deal with mature technologies in stable markets. Secondly, as Sirbu and Zwimpfer have demonstrated, the pendulum of rationale has shifted away from reaction in order to achieve compatibility, and towards proaction aimed at market creation through reductions in product variety. Thirdly, reactive standards tend to be first developed at lower institutional levels (ie local and national) and then in some cases harmonized at higher levels. The proactive approach aims first at the international level, with harmonization being achieved as the standard filters into the lower levels.

Fourthly, as reactive standards deal with established technology, they are also likely to deal with technical specifics in their state-of-the-art forms. In contrast, it has been illustrated that proactive standards are mostly consigned to deal with lower levels of technology, resulting in the production of varieties of "fundamental" standards in the form of conceptual frameworks - "reference models" as they are often called - so that further innovation will not be inhibited.(7) In the proactive mode there is scope for the coexistence of competing technologies rather than an insistence on consolidation or outright choice from among alternatives.

Thus, proaction refers to a change in context for the practice of standardization itself. In CIT at least, the activity has moved from the rear-guard of industrial planning and towards the front-lines. The emphasis is on creating a suitable environment such that service applications become possible within a reasonably competitive community of service/equipment providers. The motivation to standardize is

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7. The writer's attention was first drawn to this feature by a comment made by a Communications Canada technology analyst, who related the observation to the "upgrade" potential inherent in the NAPLPS standard.

presented whenever a highly decentralized service rationale becomes dominant; whenever there are minimal affinities between a service user and a discrete service or equipment provider.

Proaction has emerged first in the CIT area in response to a challenge to incorporate elements of the separate industrial cultures which have surrounded communications and information technologies. In turn, the proactive approach has resulted in new concepts of what a standard is and how it should function.

The main rationale for reactive standards has been to solve common recurrent problems. This is reflected in the means-directed technically framed definitions given in Chapter Two.(8) The present study indicates that proactive standardization is more of a strategy by which suppliers and/or users can act in order to effect the perception that an intrinsically dynamic technology has *slowed and/or disclosed its pace of development* sufficiently that advantageous market conditions for the application of this technology may begin to consolidate.

When suggesting future implications of the procedural adjustments evident in proactive standardization, it must be remembered that proaction was a response to the exigencies of infrastructural technologies. CIT has emerged as the "backbone" of industrial society; there are few industrial

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8. Cargill describes the technical approach to standards definition as mistakenly regarding "the *way* to standardize something as the rationale for standardization." Cargill. p. 5.

applications remaining, and fewer still being envisioned which do not relate to the application of some form of electronic message transfer. In this respect, proactive CIT standards already permeate the broad industrial fabric, and the influence of this mode of practice may well be exerted in future upon the standards-setting environment for other forms of fast-paced technology.

Most significantly from the standpoint of planning future research, proaction highlights the usually overlooked non-technical side of standardization. It is a reminder that despite the preponderance of a technical discourse, the ultimate aims of standardization are not technical but

rather economic and social. In terms of the skeletal theoretical structure suggested by the writer, proaction demonstrates the importance of basing future studies on a recognition of Primary Level structures and relationships. In further examinations of standardization, regardless of subject orientation, there is great scope for generating a closer understanding between the social and technical sciences.

APPENDIX I

List of Acronyms

AFNOR	-	Association Française de Normalisation
ANSI	-	American National Standards Institute
BSI	-	British Standards Institution
CCI	-	International Consultative Committee (of the ITU)
CCIR	-	International Consultative Committee for Radio
CCITT	-	International consultative Committee for Telephone and Telegraph
CEN	-	European Committee for Standardization
CENELEC	-	European Committee for Electrotechnical Standardization
CEPT	-	European Conference of Postal and Telecommunications Administrations
CIT	-	Communications and Information Technology
CNCP	-	Canadian National - Canadian Pacific Telecommunications
COS	-	Corporation for Open Systems
CSA	-	Canadian Standards Association
CT	-	Communications Technology
DIN	-	Deutsches Institut für Normung
DISC	-	Delivery of Information Solutions to Customers
DOC	-	Canadian Government, Department of Communications
DTI	-	UK Government, Department of Trade and Industry
EC	-	Commission of the European Communities (civil service of the EEC)
EEC	-	European Economic Community
ETSI	-	European Telecommunications Standards Institute

FCC	-	US Federal Communications Commission
GATT	-	General Agreement for Tariffs and Trade
HDTV	-	High Definition Television
I&C	-	Information and Communications Technology
ICCP	-	OECD Committee for Infromation, Computer, and Communications Policy
IEC	-	International Electrotechnical Commission
IEEE	-	Institute of Electrical and Electronic Engineers
ISDN	-	Integrated Services Digital Network
ISO	-	International Organization for Standardization
IT	-	Information Technology
ITU	-	International Telecommunications Union
IWP	-	Interim Working Party
JTC 1	-	ISO/IEC Joint Technical Committee 1
NAPLPS	-	North American Presentation Level Protocol Syntax
NBS	-	US National Bureau of Standards (now NIST)
NIST	-	US National Institute of Standards and Technology (formerly NBS)
OECD	-	Organization for Economic Cooperation and Development
OSF	-	Open Systems Foundation
OSI	-	Open Systems Interconnection
PDI	-	Picture Description Instruction
PLP	-	Presentation Level Protocol
RPOA	-	Recognized Private Operating Agency (ITU)
SCC	-	Standards Council of Canada
SG	-	Study Group
SPAG	-	Standards Promotion Application Group

SWO	-	Standards Writing Organization
"T1"	-	US committee for telecommunications standards sponsored by the industry through the Exchange Carriers Standards Association
TC	-	Technical Committee
TCTS	-	Trans-Canada Telephone System (now Telecom Canada)
VC	-	Virtual Circuit
WG	-	Working Group

APPENDIX II

The OSI Reference Model

In 1977, the ISO initiated a program to develop standards by which computer systems of differing manufacture and national origin could communicate with each other. Historically, networking capabilities have been of a *closed* variety - tied to equipment either proprietary to one manufacturer, or otherwise restricted as to choice. Investment in installed equipment bases tied to proprietary network architecture, has acted both to stimulate and retard development of open systems. On the one hand there is the user desire to be independent of particular suppliers, but on the other hand there is the problem of "stranded investment" in existing equipment and systems.

In undertaking standards development in this area, the ISO standards committees had to find a path between the user desire for independence from suppliers and the supplier requirement to maintain product distinctions in the marketplace. The task was guided by the recognition that there were many separate service functions involved in computer communications and that common standards were neither required nor appropriate for every possible interface. The principle adopted was that standards should be applied only to the external interface between *equivalent* service functions. By this means it could be ensured that computer designers retained the freedom to structure internal interfaces (ie those within discrete systems) in whatever fashion they wished. The envisioned result was to provide a framework within which innovation could occur in such a way as not to threaten interconnectivity.

The framework eventually adopted was called the Open Systems Interconnection Reference Model (variously referred to as OSIRM or simply OSI). The model identifies seven service layers and arranges them in a hierarchical sequence in which each successive layer draws upon services provided by the previous layers with there never being any arbitrary connection between non-adjacent layers. The overall concept of the OSI hierarchy is that the service functions are cumulative; each successive layer adds some level of service to that provided by the layers beneath it in the reference model.

LAYER 7	**Application**	Protocols for general applications by the end user.
LAYER 6	**Presentation**	Provides a common representation of the information as it is transmitted from one system to another. Concerned with information coding and translation.
LAYER 5	**Session**	Synchronizes the interactions between the communicating systems.
LAYER 4	**Transport**	Provides various "quality levels" for the communications service and selects between them depending on the requirements of the desired service.

LAYER 3	**Network**	Protocols for routing of the information. X.25 is the pivotal standard at this level.
LAYER 2	**Data Link**	Detects errors in transmission and provides for retransmission.
LAYER 1	**Physical**	Protocols concerning the physical media of data transmission.

The seven layers in the reference model are often explained further in terms of three basic conceptual functions.

Layers 1, 2, and 3 provide the actual network.

Layer 4 assures a reliable connection between the upper three layers and whatever quality of network is provided by the lower three.

Layers 5, 6, and 7 are concerned with making the network perform correctly when applied to actual tasks.

The objective of OSI is to develop standard communication conventions - called "protocols" - for each of the seven layers. The nature of the interface between the layers within each separate system remains the prerogative of the manufacturer. Indeed, a manufacturer could decide to integrate several of the layers into a single physical component; provided that the OSI protocols are not interfered with, the system could still conform to OSI. The basic "rule" of OSI has been stated as: "...protocols are standardized, but the internal organization of the system is not standardized."(1)

Conformance with the protocols is meant to ensure that information can be passed from a specific OSI layer on one system to the equivalent layer in another system regardless of the internal specifications of the systems involved. Once the information is transferred, it may be routed to other service layers according to the internal configuration of the receiving system.

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1. OECD, ICCP, *Standards in Information and Communications Technology* (Paris: OECD, 1987), p. 32.

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