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THE CODIFICATION AND DIFFUSION OF KNOWLEDGE IN THE TRANSACTIONAL STRATEGY OF FIRMS

Max BOISOT

INTRODUCTION

This paper explores in a preliminary way, the influence exerted by information, the conditions of its production and the possibilities for its diffusion, on an economic agent's transactional strategy. It does this by presenting a simple framework that captures two of the key information characteristics thought to be relevant to an agent's choice of transaction mode: how well the information is formed; and how extensively it has been diffused. This is an exercise in theory building and no adequate empirical evidence has as yet been collected to test the framework. For the time being therefore, the case for it rests largely on analytical grounds.

The paper subdivides into four main parts. In the first, the framework is built up from a discussion of the two information attributes under consideration: codification and diffusion. At this point the framework (to be known henceforth as the codification-diffusion, or C-D framework) has a general application. In part two it is applied to the corporate case, a shift in focus that calls for a further elaboration of the concepts it develops. In part three some of the transactional concepts that have been developed recently within the field of institutional economics are briefly described and used to assign transactions within the framework.[1] The results of this exercise are briefly discussed in part four and followed by a number of recapitulative points.

I. THE C-D FRAMEWORK THE GENERAL CASE

How do we deal with environmental complexity? How do we resolve the incohate flux of data that assails our senses every waking second of the day into a tolerably stable phenomenal world within which we can move and have our being? Recent investigations in the field of cognitive psychology point to codification as the key data reducing activity which tames the potentially chaotic experience and harnesses it to our understanding.[2]

[1] A firm's transactional strategy, whether or not it is systematically developed, is here taken to mean its preference for conducting given classes of transactions through markets, hierarchies or federations. This is the subject matter of institutional economics as initially developed by R. Coase (1937) and J. Commons (1934) and subsequently by O. Williamson (1975).

[2] The term used by Bruner for this data recuction is "*coding*"; it describes a strictly personal activity. Our preference for the term *codification* is due to the fact that it goes beyond the personal act of coding to encompass a social process. See Bruner (1974).

Codification is a form giving activity which attempts to respond to the flux of the phenomenal world by structuring it through its most accessible states in order to represent it. In this restricted sense codification is little different from categorisation; both reduce the complexity of an environment through the ordering and relating of events or classes of events.[3] Codification can take place at the level of the senses, as when the constellation of green and brown dots on a canvas suddenly resolve themselves into the foliage and branches of a tree as one steps back from a painting; it can be behavioural, as with the mime who, in a few facial gestures, can convey to a large audience anyone of the 250,000 expressions that the human face is capable of[4]; it can be conventional, as with a language that provides a limited set of rules for expressing infinitely many thoughts and responding to infinitely numerous situations[5] and finally, it can be highly abstract and removed from immediate perception, as in the case of a price system, which can signal in a summary form, subtle changes in the quality of a product or in the technical conditions of its supply.

Complex phenomena are more difficult to codify than simple phenomena: their most accessible states are not necessarily the most representative. In a complex system the properties of the parts, and of their interaction, allows no simple prediction concerning the properties of the whole.[6] Complexity thus makes for uncertainty.

Any process of codification involves some loss of information. By selecting the most accessible among a set of possible states as a basis for classification or coding one is denying oneself any ready reference to states not so favoured and these may become lost to view. By such a process of classification, objects are identified which may differ from one another in every particular.[7]

Codification, by giving form and structure to the phenomenal world, makes it accessible to communication processes. But a code must be shared if it is to serve the purposes of "collective representation"[8]; it must result from a social convention, consciously or unconsciously developed, stipulating symbols that address a finite range of events or experiences only. No amount of verbal description of a self-portrait by the later Rembrandt, for example, will adequately replace its direct contemplation. Conversely, it would be quite impossible to convey the discursive complexities of a building contract through a painting. A community, nevertheless, extends the realities within its reach by developing new codes and adding these to its existing repertoire of codes.

[3] Bruner, Goodnow, Austin (1956).

[4] Birdwhistell (1973), p. 8. The author's book is concerned to show that any deliberate human movement or expression can be codified.

[5] Chomsky (1965), p. 6.

[6] Simon (1969), p. 86. This is a subjectivist view of uncertainty.

[7] Polanyi and Prosch (1975), p. 51. The organizational consequences of this loss of information as it flows up or down managerial hierarchies has been explored by Williamson (1967).

[8] The term is Durkheim and Mauss's. See Durkheim and Mauss (1963).

Codified knowledge, by drawing on shared conventions, is diffused within a community, and, to varying degrees, becomes public knowledge. Uncodified knowledge, on the other hand, has much more limited possibilities of diffusion; it is tacit and personal and represents an accumulation of experience over time, the outcome of "learning by doing," that can only be shared with those that have partaken of the experience itself. This is the kind of knowledge that is transmitted from master craftsman to apprentice by force of example over a number of years; it yields insights which cannot be effectively diffused by other than time-consuming interpersonal means.[9]

Rarely does a uniform distribution of knowledge occur throughout the social space. Not only do people's personal experiences differ, but not everyone has equal access to the community stock of codes: esoteric knowledge may only be available to a priesthood or an aristocracy; technical secrets may be jealously guarded by a given occupational group; certain forms of speech may become the cement that binds a socioeconomic group together[10]; and so on. In this way the diffusion of codified knowledge is constrained by the erection of social and institutional barriers.

The process of codifying and diffusing new knowledge is costly, whether measured in time, effort, anguish, or money. Codifying it is a form of problem-solving, of devising reliable and specific solutions under specific circumstances. The costs of codifying are the costs of searching, identifying, testing and evaluating possible solutions —and starting again! The process is iterative, and, where successful, it becomes convergent: the range of possible outcomes to the problems addressed narrows over time and eventually leads to a "puzzle-solving" activity which, for Kuhn (1962) characterizes "Normal Science." As the early uncertainties of the search recede, the systematic nature of the phenomena under investigation became increasingly apparent and gradually crystallize into a new model —a paradigm— that serves to guide and given coherence to future research.[11] The costs of diffusing newly codified knowledge on the other hand, however varied the process may appear at different times and places, are essentially those of overcoming the three fundamental problems of communication first identified by Claude Shannon in 1949: how accurately can the information be transmitted? How precisely does the transmitted information convey the desired meaning? How effectively does the received meaning affect conduct in the desired way[12]?

Rarely does anyone knowingly incur the costs of creating and diffusing new knowledge without expecting some kind of benefit from the process, and over the

[9] Polanyi (1958).

[10] These are termed by Bernstein "Restricted codes". See Bernstein (1973).

[11] Kuhn (1962). Kuhn's own distinction between "normal" science and "revolutionary" science makes it clear that the early stages of codifying new knowledge are much more hazardous and uncertain than the later stages.

[12] Shannon & Weaver (1949).

last three centuries two institutional devices have evolved to secure the protection of intellectual property.

Both the research report and the patent, by institutionalising the publication mechanism, conditionally place control of the diffusion process in the hands of the knowledge creator, thus allowing him, by operating the barrier to diffusion, to make the fruits of his labour an object of exchange. In the case of disembodied or abstract knowledge, information is exchanged for recognition by colleagues[13]; in the case of a new technical process or product, information is exchanged for temporary monopoly profits secured through a patent system.

In both, the *adaquacy* of the claim that new knowledge has been created is tested by encoding it in a form acceptable for publication, and its *value* is tested by the use to which it is subsequently put.[14]

The discussion so far has argued that there is some positive relationship between the extent to which knowledge is codified and the extent to which it is diffused, and that this can be evidenced by the fact that institutional barriers have to be set up to bring the diffusion of newly codified knowledge under some kind of control whether for economic or social purposes.

Codification and diffusion, are each presented as a dichotomised dimension of the diagram in Fig. 1. When cross-classified, they yield the following four types of knowledge available to an individual or a group:

A. *Personal Knowledge*—the tacit knowledge that is unique to an individual or subgroup as they accumulate experience but that remains mostly uncodified and undiffused.

B. *Proprietary Knowledge*—knowledge that has been codified, but that has not as yet been diffused; it constitutes a private repertoire of potentially diffusible knowledge.

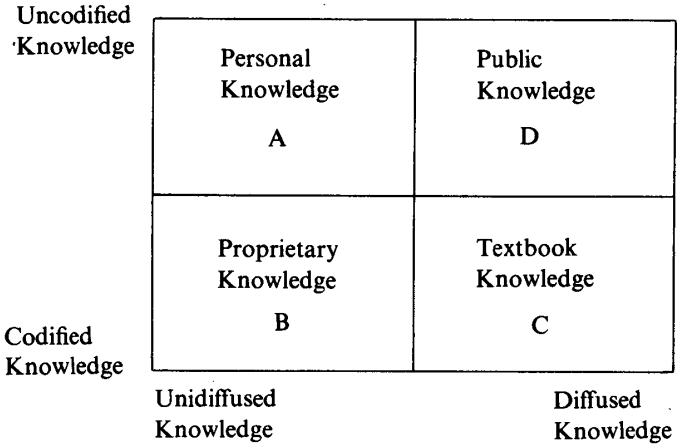

Fig. 1. The C-D Framework: the General Case.

[13] Hagström (1965).

[14] Ravetz (1973), p. 274. As this point makes clear publication is a necessary but not sufficient condition for diffusion. Codification secures the *diffusibility* of knowledge, not its diffusion.

C. *Textbook Knowledge*—codified knowledge which has been diffused and is therefore available as part of an established repertoire in the public domain.

D. *Public Knowledge*—the tacit knowledge that all those who partake in the culture of a given group or community are presumed to share.

This simple framework allows a description of the way that the knowledge accumulated by an individual or subgroup can be distributed at any given moment in time. What stands in any of the four quadrants constitutes their total investment in knowledge, and since, over time, an item of knowledge can flow from one quadrant to the other, the investment pattern will be modified. This flow of knowledge must now be examined more closely.

1. *Codification*

Any downward movement in the diagram from A to B or from D to C describes at attempt at codifying what has hitherto been experienced as tacit knowledge. Experience is gradually rendered systematic and structured, and eventually can even be routinised and programmed. This is the habit-forming operation through which cognitive and behavioural skills are learnt and built up. An upward movement from B to A or from C to D, conversely, describes an application of existing codes to experience. To every new experience one brings consciously or otherwise a disposition to encode it along the lines of least resistance, in the first instance usually through one's mother tongue.[15]

When this vertical traffic up and down the diagram occurs on its right hand side, a communal form of learning results. When it occurs on the left hand side of the diagram, the kind of learning that takes place is unique and may, by degrees, separate the individual or subgroup from the wider community. But working in relative isolation, and possibly less constrained or influenced by more conventional thought process, such an individual or subgroup, stands a better chance of producing genuinely new knowledge.

2. *Diffusion*

Diffusion is a horizontal movement. In the top part of the diagram it requires direct interpersonal contact since knowledge has not been codified and will most likely be transmitted by example. In the bottom part of the diagram codified knowledge can travel by impersonal means in print, picture, tape, product, etc. Uncodified knowledge will travel more slowly than codified knowledge; not only will each communication act require more time for demonstration, the reception of feedback, repetitions, learning, and so on, but it will at best be addressed to a small group of people in a face-to-face situation. Codified knowledge, conversely, can more readily take the form of a mass broadcast in which a large target

[15] This is the sense of Hanson's point that the act of observation is not innocent but is "theory-laden". See Hanson (1958).

audience is reached simultaneously. The costs of diffusion per recipient will be lower in the latter case, but the knowledge transmitted will have to be more standardised, and by implication, less complex and uncertain.

Knowledge travelling from D to A or from C to B is already public; it flows from large social aggregates to smaller groupings or from groups to individuals through a scanning process. Its subsequent processing may remain undiffused and hence takes place on the left of the diagram. The information conveyed may describe pressing social, technical, political, or moral issues that beset the wider community. New knowledge, however, codified and uncodified, always travels from left to right in the diagram and describes a diffusion process from singular sources.

The flows of knowledge through the four quadrants as described, have a random character that probably characterises their behaviour at any given moment when analysed in an atomistic fashion. Over time, however, and in the aggregate, flows of new knowledge appear cyclical and move counter-clockwise from quadrant to quadrant. Knowledge which was tacit and personal to creative or inventive individuals, may become proprietary to their successors, textbook knowledge to their children, and mere common sense to their grandchildren. The resulting cycle is, in effect, an idealisation of what happens in reality since much movement either peters out, giving way to new flow patterns, or leads up the innumerable blind alleys that constantly beckon on those who seek knowledge.

The cycle can be broken down into four steps each reflecting the counterclockwise move from quadrant to quadrant.

Step 1: Need Formulation—The Move from D to A
Step 2: Knowledge Creation—The Move from A to B
Step 3: Knowledge Diffusion—The Move from B to C
Step 4: The Absorption of Knowledge—The Move from C to D.

In the knowledge creation cycle just outlined, only the horizontal flows of well codified knowledge between B and C are visible. They are also the fastest. By contrast, the absorption of knowledge and its consolidation through experience, the transmission of new problems and opportunities it provokes, and the generation of new knowledge that ensues—moves in the cycle from C through D back to A and B— are all hard to discern (being either undetectable or undiffused) and slow. In effect, what one generally sees of the creation and diffusion of knowledge is just the visible tip of the iceberg.

II. THE CORPORATE CASE

The C-D framework presented in the preceding section will now be adapted and applied to the corporate case. The dichotomy that has been used to present a polarised relationship between the cognitive attainments of an individual or small group and those of the wider society to which they belong, will be replaced by a trichotomy that links somewhat more narrowly a social construct[16] —the com-

[16] For a discussion of the organization as a social construct see Crozier and Fiedberg (1977).

mercial organization— to some of its relevant publics.

The flourishing of contingency theories of organization in the 1960s[17] pays a belated tribute to the experienced complexities of organizational processes whilst at the same time rebelling against the conceptual regimentation of earlier theorists such as Frederick Taylor and Henri Fayol. In particular, the uncertainty and complexity of task and environment emerged a important determinants of organizational behaviour both within and between subunits.[18] This points to the possibility of applying to organizational units and subunits the codification dimension that was developed in the previous section. The extent to which organizational knowledge has been codified is a measure of how far uncertainty has been "absorbed" or reduced.[19]

In looking at the corporate case, the codification dimension of the framework is now trichotomised into the categories of Uncodified, Semi-codified, and Codified knowledge. Such a refinement helps to rank organizational subunits by decreasing complexity and uncertainty and on this basis to assign each of them to different locations in the framework along this dimension. As will be seen below, a similar assignment of organization subunits is made along the diffusion dimension.

1. *Uncodified Knowledge*: (*U*)

This is the tacit knowledge built up by experience that was encountered in the preceeding section; the costs of acquiring it are reckoned in units of time and variety of exposure. It is impressionistic and uncertain, and diffuses best in small face to face groups. Organizational units or subunits whose operational effectiveness rests predominantly on the use of uncodified knowledge often find it difficult to use formal management control systems. The management style that results is described as strategic and is typically found in the top echelons of an organization: in the boardroom, the basic research laboratory, in the corporate relations department and so on. In Burns and Stalker's terminology, it is "organic."[20]

2. *Semi Codified Knowledge*: (*S*)

Here uncodified and codified knowledge coexist. Some organizational activities, although themselves well-defined and certain, are embedded in a matrix of vague and elusive prescriptions. Inputs such as costs, or outputs such as objectives may be formalised, but the way one is transformed into the other remains what cyberneticians call a 'black-box' —i.e., ill-understood. The management control style called for by organizational units using mainly semi-codified knowledge is one of direction and persuasion[21]; it will most likely be applied to the running of

[17] See for example Burns and Stalker (1961), J. Woodward (1965), Lawrence and Lorsch (1967).

[18] Hall (1977).

[19] According to March and Simon uncertainty is absorbed by organizations, through a process of "routinization". See March and Simon (1958).

[20] Burns and Stalker, *op. cit.*

[21] According to Antony, management control cannot be reduced to pure routine; hence the need for direction and persuasion. See Antony (1965).

organizational units such as an applied research or development laboratory, a small or medium sized overseas subsidiary, or a marketing department.

3. *Codified Knowledge*: (*C*)

Codified knowledge exhibits the least amount of uncertainty, and, once mastered, complexity. The relationship between organizational inputs and outputs is well understood (i.e., there is no 'black box,' or if there is, it is a small one) and can be routinized or programmed. This is the kind of knowledge that can be systematically embodied in physical objects, allowing men to be replaced by machines, computers, industrial robots, numerically controlled machine tools, and the like. The control techniques required are impersonal and can take a written (or punched!) form. They can also be highly centralised —much as the operations they are applied to may themselves remain decentralised. Both production and sales —in many industries, now highly codified activities— are becoming increasingly amenable to this form of control. burns and Stalker call it "mechanistic."[22]

As with codification, the diffusion dimension will be trichotomised to describe two barriers to the diffusion of corporate knowledge: one operated by a firm itself, another by the industry or industries within which it falls. The categories developed are an adaptation of those developed by Hall and Johnson and by Teece[23] in his study on the resource costs of technology transfer by multinational firms. The trichotomy distinguishes between firm-specific, industry-specific, and market-specific knowledge, thus reducing the polarisation created earlier to illusrate the difference between the knowledge held by an individual or small group and that available to the wider society. The resulting dynamic, however, is not affected.

Firm-Specific Knowledge (*F*). Firm-specific knowledge will here be taken to mean knowledge available to only one producing firm. The firm has some measure of control —backed by laws or other means of enforcement— over the diffusion of any new knowledge it creates, the terms on which such diffusion will be allowed to occur, and its extent.

Much of a firm's research output is firm-specific, but so are innumerable specialist practices developed in the course of a firm's activities as it learns to cope with unforeseen, and often unique, technical and administrative problems experienced for the first time and hence not encountered elsewhere. Indeed many currently established management practices started life as the property of a single organization, as part of its firm specific knowledge.

Industry Specific Knowledge (*I*). This is knowledge —tangible and intangible— available to all producing firms within a given industry. It describes current practice within an industry or what its members can be presumed to know. It is the type of knowledge used in production, in general management, and in the

[22] Burns and Stalker, *op. cit.*

[23] Hall and Johnson (1970), Teece (1976).

shaping of corporate strategy. It is not as a rule diffused to customers outside the industry and is a source of competitive strength for the industry as a whole.

Market-Specific Knowledge (*M*). What in the preceeding section was available to all —public knowldge— is here reined in a little to become accessible only to the consumers of an industry's products and services as well as to the producers themselves. Much market-specific knowledge is deliberately transmitted by producers to actual or potential consumers with a view to increasing the overall size of the market for their products and their share within it. Its essential function is to inform, motivate, and to hold customers. Some knowledge, however, will be produced by customer groups themselves —consumer association, buying cooperatives, etc.— or by their represenatives such as government information agencies, public health authorities, and so forth. Producers will also draw upon market-specific knowledge in shaping their sales, marketing, and new product strategies.

Knowledge codification and diffusion has been somewhat more particularized and articulated in the corporate than in the general case. Codification has been given an organizational context and diffusion an industrial one. In each case it has been possible, if only approximately, to position a number of organizational subunits along the two dimensions created. The framework that emerges, and the position tentatively assigned to organizational subunits within it, are outlined in Figures 2 and 3. The letters inside each box are the alphabetical coordinates of the categories created.

The knowledge creation cycle is at work in the corporate case no less than in the general case earlier described. Firms can invest in the knowledge creation cycle

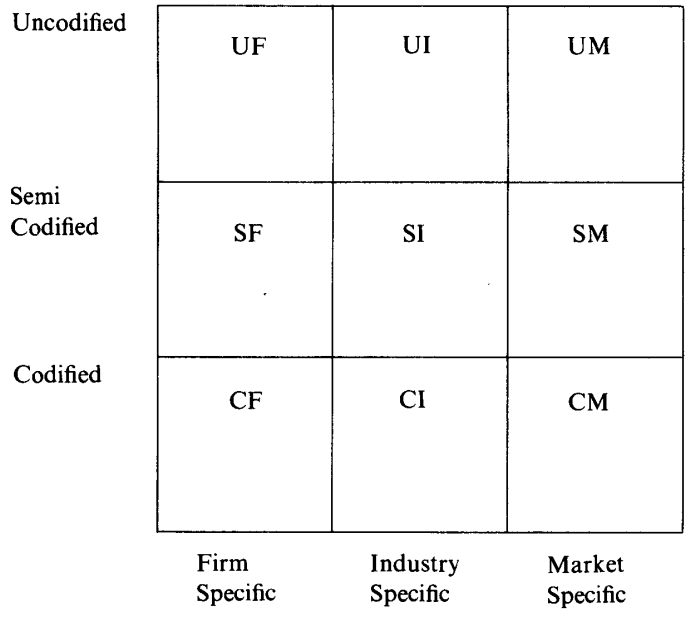

Fig. 2. The C-D Framework: the Corporate Case.

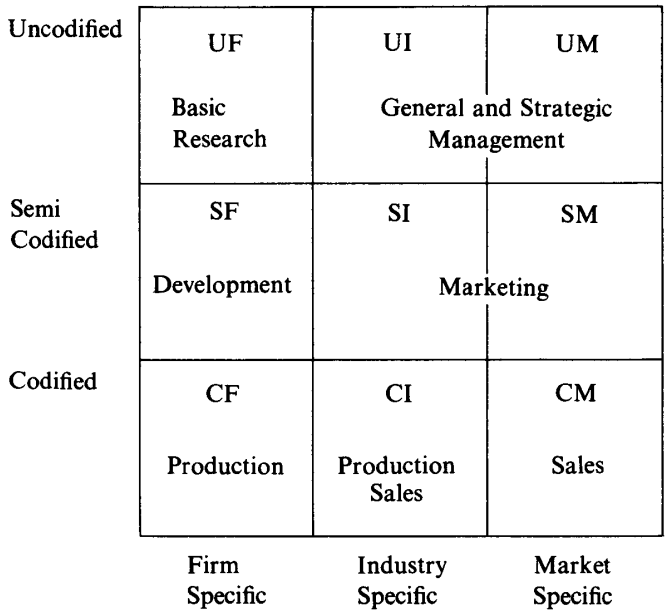

Fig. 3. The C-D Framework: The positioning of organizational subunits.

either by spreading their available resources throughout the diagram so as to complete the cycle on their own, or by concentrating them in order to achieve a distinctive strength on one or two laps. They can develop a general capability in strategic management, research and development, production and marketing, or, they can become primarily research oriented, marketing oriented, and so on. For the larger firm, these are not exclusive choices; both options may be affordable depending on the minimum investment required to build up a distinctive capability in a given industrial sector. The firm's choice will be influenced by what competitors are doing and by industry characteristics. Up to a certain level of competitive intensity the firm will feel that its prospects are enhanced by the creation of new proprietary knowledge; beyond that level, the proprietariness of such knowledge can no longer be safeguarded and will in any case be limited in its value by the emulative efforts of a firm's rivals. As prospective payoffs to innovation are eroded by sharper competition, investments in the more uncertain segments of the cycle such as R and D may come to be seen increasingly as so many squandered resources. Firms will then hold back from undertaking such investments, and the flow of knowledge through that part of the cycle will start to slow down.[24]

Firms which concentrate their investments may do so in F, in I, or in M in the diagram: they may build up a specialized competence around a single proprietary product group in F; they may exploit a geographical location to become an established supplier in I to a local industry with little need to market or to innovate; or they may develop their skills as a buyer in M, backed by a strong

[24] For a discussion of the effects of competition on a firms' innovative efforts see Scherer (1965) and Mansfield (1968).

investment in distribution. Any subsequent attempt to integrate backwards or forward by such firms moves them respectively to the left and to the right of their position in the diagram where they may face industry or market barriers to entry and will certainly need to acquire the skills and know-how that go with their new position. They can either buy the knowledge they need as a 'package,' through a merger or the acquisition of an existing firm, or they can build it up more slowly for themselves, by initially mastering the established and codified repertoire of "textbook" skills that has accumulated in the bottom part of the diagram, and letting them fertilize the new experiences that now confront them in S and in U.

In confronting this "make or buy" decision with respect to the use and development of its knowledge assets, the firm is addressing transactional issues that have recently re-emerged in the field of institutional economics. These will be briefly explored in the next section.

III. MARKETS AND HIERARCHIES

In this section the "single actor" assumption —whether he be individual or corporate— that has so far helped to simplify the analysis will be discarded. Interfirm as well as intrafirm flow will be admitted. Also, the emphasis now shifts from knowledge flows within the C-D framework to the *transactions* that give rise to such flows. In the aggregate, transactions create knowledge flows by stimulating interactions in which information is exchanged. Transactions may occur anywhere within the framework as developed and will display the information characteristics of the cells to which they have been assigned. But now the transaction mode is subject to a process of analysis and choice. It can either be internalized by firms and made subservient to organizational goals and controls, or it can be left to the self-regulating tendencies of a market or other institutional devices. The section draws heavily on some of the recent work in the field of institutional economics currently associated with the name of Oliver Williamson. Building on tradition that goes back to John R. Commons and R. H. Coase,[25] institutional economics makes transactions the ultimate units of microeconomic analysis. Williamson sums up the approach as follows:

"1. Markets and firms are alternative instruments for completing a related set of transactions.
2. Whether a set of transactions ought to be executed across markets or within a firm depends on the relative efficiency of each mode.
3. The costs of writing and executing complex contracts across a market vary with the characteristics of the human decision makers who are involved with the transaction on the one hand and the objective properties of the market on the other.
4. Although the human and environmental factors that impede exchanges

[25] Commons, *op. cit*; Coase, *op. cit.*

> between firms (across a market) manifest themselves somewhat differently within the firm, the same set of factors apply to both. A symmetrical analysis of trading thus requires that we acknowledge the transactional limits of internal organization as well as the sources of market failure. Basic to such a comparative analysis is the following proposition: just as market structure matters in assessing the efficacy of trades in the market place, so likewise does internal organization."[26]

In his book *Markets and Hierarchies*, Williamson discusses a number of characteristics through which transactions can be analysed. The most important are set out below.

Uncertainty and Complexity: Uncertainty is a product of environmental factors, but it can also result from computational inabilities when confronting even a comparatively certain environment. Complexity incorporates uncertainty, but is further qualified by the presence of interdependent elements, as well as by a certain vagueness or lack of definition of either inputs or outputs. Complexity reflects the multiplicity of contingencies to be dealt with in a given situation[27] and consequently requires a measure of synchronization of activities as transactions proceed as well as a higher level of feedback between them. Transactions that are uncertain or complex would be defined as uncodified in the C-D framework.

Bounded Rationality: According to Simon[28] "the capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems where solution is required for objectively rational behaviour in the real world." In this sense bounded rationality describes a relationship between the rationality reeded and the rationality available. Its manifestations only become interesting under conditions of uncertainty or complexity when limits on rationality are effectively reached. Means can be devised for economizing on bounded rationality such as coding or converting problems into a sequential form —i.e., by programming them. Organization structures are cited by Simon as instances of economies on bounded rationality. In the C-D framework, the phenomenon will more likely manifest itself when confronted with uncodified rather than codified knowledge providing of course that the relevant codes have already been mastered.

Small Numbers Bargaining: Perfectly competitive markets require the involvement of large numbers for their effective performance. Small numbers bargaining describes the absence of this condition; it points to bilateral monopolies, oligopolies, and a general lack of fungibility in transactions. Firm-specific knowledge would best describe such a condition in the C-D framework, but it could be found anywhere within it, since, for exmple, a monopoly, under certain circumstances, could operate on the basis of market-specific knowledge alone.

[26] Williamson, *op. cit.* pp. 8, 9.
[27] Butler (1980).
[28] Simon (1957).

Opportunism: The joining of uncertainty with bounded rationality and small numbers bargaining leads to opportunism, a condition in which, superordinate goals are sacrificed to sectional interests. Codification is one of the devices used by organizations to cope with opportunism, which, in a C-D framework, would tend to emerge in UF.

Idiosyncratic Knowledge: Knowledge of "particular circumstances of time and place"[29] can be termed idiosyncratic and confers "first mover" advantages on its possessor. It is generally acquired "on-the-job" and economizes on bounded rationality in idiosyncratic job circumstances. At the same time it can give rise to internal opportunism within firms and can only be avoided by shunning idiosyncratic technologies and techniques in favour of more standardized operations. Idiosyncratic knowledge is usually uncodified and may become firm-specific in the sense that no equivalent know-how may be readily available outside a given firm.

Information Impactedness: This desctibes a condition in which the true underlying circumstances concerning a transaction are known to only one of the parties involved and cannot be costlessly disclosed to the other. The asymmetrical distribution of knowledge concerning a transaction gives rise to "moral hazards"[30] —the temptation for one of the parties to behave opportunistically— if there is a cost to achieving information symmetry. Information impactedness will affect firm-specific knowledge in the C-D framework, but not exclusively so; it also has a greater application in the case of uncodified than of codified knowledge.

Strategic Behaviour: The conditions that give rise to opportunism derive from an actor's strategic behaviour — described by Williamson as the pursuit of self-interest with guile. It implies the withholding of impacted information in such a way as to conceal strategic intentions or at least make them ambiguous. This kind of behaviour is effective in a C-D framework when it draws upon firm-specific knowledge, but it can be equally so when market-specific knowledge is impacted, as with, say, foreign markets.

Atmosphere: It often happens that the transaction itself can be regarded as an object of value and that the prevailing norms of reciprocity also make it difficult to insist on the contractual completeness or the exacting execution of a transaction. "Atmosphere" sums up the attitudinal and value factors that motivate a transaction in a given context. They are likely to count for more in those transactions that depend on the use of uncodified knowledge.

For Williamson, firms and markets coexist in symbiotic equilibrium; they offer alternative, and complementary means of organizing technologically separable activities, and the choice between them will be made on the basis of their respective costs and benefits. Firms, through a process of hierarchical control, subordinate

[29] The expression is Hayek's. See Hayek (1945).

[30] The "moral hazard" problem is discussed in Arrow (1969). A point that is frequently overlooked by those who address the issue is that its intensity will vary with the value systems of the transacting parties, and with the extent to which these converge. One is less likely to behave opportunistically with a fellow member of one's club than one is with a perfect stranger.

the goals and behaviour of their members to a dominant set of objectives. Markets serve a broader range of objectives than firms, but through a process of self-regulation that does not yield the type of efficiencies achievable by hierarchical means. Intermediate between hierarchical and market transaction modes, and somewhat neglected by Williamson in this analysis, lies what could be called a communal, or federative transaction mode[31] which, whilst unable to establish control by fiat as can a hierarchy, aims at a more efficient realisation of a more limited number of goals than does a market. Like markets and unlike hierarchies, federations set up lateral relationships between transacting parties. But they differ from markets in that they involve small numbers rather than large ones and their effectiveness often depends upon face to face negotiations rather than the free play of impersonal market forces. A federation offers a transaction mode based on peer group interaction; it is more political in nature than the other two modes and will show a greater sensibility to atmosphere. Williamson sees such peer group arrangements as inherently unstable and open to "free-rider abuse"[32] leading eventually to a switch to one of the two other modes available. Yet in dismissing federations in this way, he is playing down the effect of social norms that may induce conformity within a peer group, and assuming away those components of atmosphere that might be developed to make this transaction mode a viable third choice. Mauss' essay on the gift[33] shows that stable and reliable transactions can occur through forms of social organization less formally compelling than a hierarchy, yet less atomistic than a market. Federations will, therefore, form part of the analysis, representing a transaction mode, viable in itself, and lying on a continuum between the indeterminate amorphous atomism of the later, and the stable, integrated structures of the former.

Transactions are assigned to markets, hierarchies, or federations with a view to minimising the total costs of executing them. Williamson's own analysis, by omitting federations from consideration, puts forward a narrower basis for assessing transaction costs than is actually necessary to his conclusions. An efficiency calculation can admit of psychic costs and benefits as well as pecuniary ones with no loss of scope, the only difference being that the endurance of federations under some circumstances is thereby better explained. The matter cannot be further pursued here and the assignment to each mode of transactions arising within the C-D framework must now be considered.

Market transaction. Contracting in the market will be economically desirable and feasible insofar as:

1. The goods or services contracted for can be defined and set down in writing.
2. They can be delivered even in uncertain circumstances without occasioning costly re-haggling as to terms and conditions.

[31] This transaction mode has been discussed by Butler (1980) and by Bauer and Cohen (1980).
[32] Williamson, *op. cit.* p. 45.
[33] Mauss (1925).

3. Monitoring and enforcing the terms of the contract is not unduly costly for either party.
4. Both parties feel they stand to gain from the contract given their circumstances. Additionally, market contracting will favour those transactions, occasional or recurrent, in which the parties can be indifferent to each other's identity and where a valuable on-going relationship is not implied.

Market transactions require large numbers bargaining to provide ready substitutes, a sufficient quantity of codified knowledge available and relevant to transactions which can speedily diffuse throughout the market and act as an input to decision-making, separable transactions that can be negociated independently thus reducing their complexity, and finally, a low degree of atmosphere, making them accessible to large numbers at low social costs. That these conditions usually only obtain in the real world at any one time for a limited class of transactions explains the fact that organizational decision-makers are constantly faced with a stream of "make-or-buy" decision. This is but a more conventional way of confronting the transactional issue.

Market transactions fail to satisfy, in circumstances which combine opportunism, bounded rationality, and small numbers bargaining.[34] Within the C-D framework, an optimal assignment would place such transactions in CM, with moves upwards or to the left creating incremental market imperfections which eventually lead to market failure and thus to federations or hierarchical alternatives.[35]

Hierarchical Transactions. Contracting through hierarchies (i.e., through an employment relation) will be preferred where:

1. There is a need to extend bounds on rationality — hierarchy does this by specializing decision-making and communication processes.
2. Opportunism due to small numbers must be curbed.
3. Interdependent units must adapt to contingencies in an interdependent way.
4. Conflict issues can be resolved by fiat.
5. Internal auditing can improve contract performance.
6. A better atmosphere is offered than in market transactions.

Hierarchies enhance the efficiency with which goals can be pursued by reducing their number and by ranking those that remain according to a clearly established system of priority. Integration is brought about through the use of authority:

"While the habitual assumption back of the decision in bargaining transactions is that of equality between willing buyers and willing sellers, the assumption back of the managerial transaction is that of superior and inferior... the superior gives

[34] Williamson, *op. cit.* p. 7.

[35] The term "market failure" has a normative connotation that is not intended here. It implies that all information relevant to a transaction *should* be codified and diffused. This overlooks the costs of moving within the framework and suggests a "free lunch" approach to the economics of information.

orders, the inferior must obey."[36]

The routinisation of decision-making and communication that hierarchy makes possible is a form of codification that enhances the organization's capacity to process a wide range of experiences, to address complex issues, to economise on bounded rationality, and to reduce dependency on idiosyncratic knowledge and hence, information impactedness. Yet hierarchies, like markets, tend to break down beyond certain limits. The codification and transmission of data across hierarchical levels create distortions and information losses[37] which pose afresh the problem of bounded rationality and give rise to internal opportunism and the pursuit of subgroup goals. The inability to resolve by fiat all conflicts between politically powerful subgroups, often result in strategic concessions that give a hierarchy an expansionary bias, and that can push it beyond a size —organizational form held constant— which this transaction mode can efficiently service. A switch of organizational form from a functional to a divisional structure will mitigate the unwanted effects of growth, but only by replacing a functional by a divisional structure and by substituting internally a quasi-market relationship between the new divisions for the former hierarchical one. They will now compete with each other in the resource allocation process, subject only to a limited control by the centre. In effect, in order to manage these constraints, the hierarchy, in its top echelons, will function like a federation.[38]

In the C-D framework the natural home for hierarchical transactions is in CF where the relevant knowledge is impacted in the firm but, because it has been codified, not in groups within it. As transactions become less codified, a federated transaction mode may be preferred. As they become less firm specific, a market transaction mode may come to be chosen.

Federated Transaction. Federations are the poor relation in Williamson's analysis. Precariously perched bwtween markets and hierarchies, they do not provide a stable home for transactions. Yet as Butler points out, their instability is a function of prevailing social conditions.[39] To a greater extent than the two other transaction modes, the viability of federations rests on prevailing cultural norms, the climate of trust and tolerance that they foster, and the styles of behaviour they legitimate.

Federations will claim those transactions whose complexity and vagueness make them refractory to treatment by markets or hierarchies, where bargaining occurs between small numbers, and where information is not so impacted in one party that it can dominate the transaction. Such circumstances make atmosphere all important as transaction will have to be completed in a climate of trust and of give and take, and any overt manifestation of calculative, maximising, or strategic

[36] Commons, *op. cit.*

[37] Williamson, *op. cit.* p. 123.

[38] For an historical discussion of the switch to divisional structures by large U. S. firms see Chandler (1966), for European firms, see Thanheiser and Dyas (1976).

[39] Butler, *op. cit.*

behaviour by one party, conducted at the expense of the other, will destroy the basis for further collaboration. Thus where a hierarchical relationship can be characterized by a measure of dominance and coercion, a federated one rests upon the use of influence through negotiation.[40] It is a political relationship in which the superordinate goals and values shared by transacting parties mutually commit them in a way that divergent goals pursued through market transactions do not. But it is also a relationship in which each partly possesses sufficient power to make the process of mutual accomodation one of continuous bargaining —albeit carried out implicitly, as in the case of oligopolistic collusion— rather than one of dominance by one party and subordination by the other, as in the case of hierarchies.

Federated transactions describe the relationsip that is gradually built up, for example, between a skilled professional and his client, between powerful groups of shareholders in a company, between large defense contractors and government officers, and, as already suggested, between the members of a management board. In all these examples, the complexity or the vagueness of the issues to be treated escape the provisions of formal contracting, whether this is done through markets or hierarchies (i.e., the employment contract), and require a high degree of trust and shared bargaining norms between the parties if transactions are to take place. This level of trust must be built up over time through extensive personal contact, and represents a sunk cost for each of the transacting parties, that increases their committment to each other. Such an investment in the transaction, however, will often only be repaid in small numbers situation, where norms of reciprocity can effectively be enforced at an interpersonal level.

Federations, like markets and hierarchies, can suffer failures.[41] At one point a concern for mutual accomodation can given way to a concern for efficiency which may drive federations towards hierarchy if goal congruence betwen the parties can be maintained. Or the complexity and vagueness of transactions is eroded by accumulated experience, so that more formalised —i.e., codified— and less 'trusting' arrangements can be reached. Finally, what started off as a small numbers situation can develop into a large numbers situation if exclusivity provisions cannot be maintained; face to face relationships will give way to impersonal ones and the enforcement of implicit bargaining norms could then become excessively costly giving rise to opportunistic behaviour. A move towards market arrangements would then become likely.

Federated transactions, depending as they do upon the deployment of uncodified knowledge, are best accomodated in UM or UI in the C-D framework where information impactedness is at a low or medium level and the scope for achievement of dominance by any one party on information grounds is therefore

[40] Bauer and Cohen, *op. cit.*

[41] Here again, the term "failure" has no normative implication. Of course, this is not how the term is seen by the transacting parties themselves should the circumstances warrant its application.

limited. With a move leftward towards firm-specific knowledge, the opportunity of switching to a hierarchical mode increases, but the uncertain nature of the information dealt with suggests that a federated arrangement will be maintained within the hierarchy in an attempt to reduce opportunistic behaviour internally while increasing the scope for the pursuit of such behaviour with respect to outsiders. Conversely, with a move downward from UM to SM or CM the opportunities for re-assigning federated transactions to the market increase.

IV. CONCLUSION

The markets and hierarchies approach developed by Williamson takes an essentially unitary view of organization: transactions are assigned to firms or to other institutional arrangements, but any further differentiation of transaction modes within a firm is not pursued. By looking at transactions in the context of a C-D framework as shown in Fig. 3 one may note that one of the information characteristics which has helped to guide their assignement to markets, hierarchies, or federations —its degree of codification— has been used by Lawrence and Lorsch[42] to establish the organizational linkages within a firm on the basis of which activities are integrated differentiated. The focus of Lawrence and Lorsch's analysis is on *intra*organizational linkages, that of Williamson on *inter*organizational ones. They share a contingency approach to the form and the content of transactions, but with Williamson putting perhaps more emphasis on the distribution of information between the parties. The preceding analysis, however, indicates that markets, hierarchies, and federations, suitably adapted, will operate *inside* firms as well as outside them, shaping the administrative style of organization subunits and setting limits to the possibilities of integration and differentiation which together they can achieve. Here institutional economics meets organization theory within a single framework.

The C-D framework, in effect, explores the political economy of information. Its behaviour over time (its flow) and at an instant (transactions) as it moves within organizations and between them, makes it a mercurial resource in the hands of those whose strategic effectiveness depends on an ability to capture it, contain it, and eventually channel it in a controlled way. A political economy of information operates beyond the confines of microeconomic analysis, narrowly defined, to encompass behavioural characteristics, now acknowledged by organization specialists, but hitherto dismissed by economists as elusive to their craft.

A number of recapitulative points can now be made:

1) The C-D framework describes the diffusion characteristics of uncodified and codified knowledge, as well as the process whereby one is transformed into another by acts of codification and accumulating experience.

[42] *op. cit.*

2) In a corporate context, acts of codification constitute an investment which is more likely to be carried out if its benefits are appropriable. For this reason the further one moves towards the left in the C-D framework the greater the tendency to assign transactions to hierarchies rather than markets.

3) Federated transactions are more likely to occur in the upper part of the C-D framework than in the lower part; but with a move leftward, they begin to compete with hierarchical transaction modes. At some point, either a switch is made from one to other, or both are maintained, but one is made subordinate to the other.

4) Market transactions are more likely to occur in the lower part of the C-D framework than in the upper part; but with a move leftward, they also begin to compete with hierarchical transaction modes. Here again, as in 3) above, either a switch is made from one to the other, or both are maintained, but one is made subordinate to the other.

5) Markets, hierarchies, and federations, compete for transactions throughout the C-D framework. Their respective competitive strengths are determined partly by exogenous institutional and cultural factors, partly by their position within the framework, and partly by how effectively diffusion and codification barriers (which include country barriers) limit their field of influence. A C-D framework dominated by a single transaction mode is perfectly conceivable, the other two remaining but latent possibilities.

In conclusion one may note that international operations by a firm subjects the C-D framework to extreme conditions. Geographical distance, cultural gaps, and differing jurisdictions, make communications difficult and diffusion costly. Additionally, the repertoire of codes, norms and beliefs used in transactions will often show little overlap. Such circumstances, as stated above, may favour market and federated transactions over hierarchical ones, so that firms which had effortlessly internalised transactions when operating within a single judisdiction, may be forced to reassign them when they come to extend their operations, abroad. Thus, markets, hierarchies, and federations all become eligible candidates for transactional re-assignments when a firm makes arrangements to invest abroad, and the presence of country barriers, in some sense, should help to explain a firm's transactional strategy within the C-D framework.[43]

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BIBLIOGRAPHY

Anthony, R. N., *Planning and Control Systems: A Framework for Analysis*. Boston: Division of Research, Graduate School of Business, Harvard University, (1965).

Arrow, K. J., "The Economic Implication of Learning by Doing," *Review of Economic Studies*, Vol. XXIX, pp. 155–173, June 1962.

[43] A transactional approach to the operations of multinational firms has been developed by Buckley and Casson (1976).

Arrow, K., "Classification Notes on the Production and Transmission of Technical Knowledge—AER," Vo. 59, N° 2, 1969, pp. 29–35.

Bauer, M., and Cohen, E., "The Occulation of Power in Economics: Beyond Markets and Hierarchies." Paper presented to the EGOS. "Markets and Hierarchies" Conference, Imperial College of Science and Technology. London, January 1980.

Bernstein, B., *Class, Codes and Control.* Herts: Palladin, (1973).

Birdwhistell, R. L., *Kinesics and Context.* Middlesex: Penguin Books, (1973).

Bruner, J. S., *Beyond the Information Given*, London: George Allen and Unwin, (1974).

Bruner, J. S. Goodnow, J. J., and Austin, C. A., *A Study of Thinking.* New York: John Wiley and Sons, (1956).

Buckley, P., and M. Casson, *The Future of the Multinational Enterprise.* London: MacMillan, (1976).

Burns, T., and Stalker, G. M., *The Management of Innovation.* London: Tavistock Publications, (1969).

Butler, R. J., "Control through Markets, Hierarchies and Communes: A Transactional Approach to Organizational Analysis and Quasi-Markets." Paper presented to the EGOS "Markets and Hierarchies" Conference, Imperial College of Science and Technology. London, January 1980.

Chandler, A. D., Jr., *Strategy and Structure.* New York, Doubleday & Co. Inc., Anchor Books Edition, (1966).

Chomsky, N., *Aspects of the Theory of Syntax.* Cambridge, Mass.: The M.I.T. Press, (1965).

Coase, R. H., "The Nature of the Firm," Economica N.S., 4, (1937), pp. 386–405.

Commons, J. R., *Institutional Economics.* Maddison: University of Wisconsin Press, (1934).

Crozier, M., and Friedberg, E., *L'acteur et le Système.* Paris: Editions du Seuil, (1977).

Durkheim, E., and Mauss, M., *Primitive Classification.* London: Cohen and West, (1963).

Dyas, G. P., and Thanheiser, H. T., *The Emerging European Enterprise: Strategy and Structure in French and German Industry.* London: Mac Millian, (1976).

Hagstrom, W. O., *The Scientific Community*, Basic Books, (1965).

Hall, G. B., and Johnson, R. D., "Transfers of United States Aerospace Technology to Japan," in R. Vernon (ed.), *The Technology Factor in International Trade.* New York: Columbia University Press, (1970).

Hall, R. H., Organizations: *Structure and Process.* Englewood Cliffs. New Jersey: Printice-Hall Inc., (1972).

Hanson, N. R., *Patterns of Discovery.* Cambridge: Cambridge University Press, (1958).

Hayek, F., "The Use of Knowledge in Society," American Economic Review, 35: pp. 519–530, September (1945).

Kuhn, T., *The Structure of Scientifical Revolutions.* Chicago: The University of Chicago Press, (1962).

Lawrence, P. R., and Lorsch, J. W., *Organization and Environment.* Homewood, Illinois: Richard D. Irwin Inc., (1967).

Mansfield, E., *Industrial Research and Technological Innovation.* New York: N.W. Norton & Co., (1968).

March, J. G., and Simon, H. A., *Organisations.* New York: John Wiley and Sons, Inc., (1958).

Mauss, M., *The Gift.* London: Routledge and Kegan Paul Ltd., (1966).

Polanyi, M., and Prosch, H., *Meaning.* Chicago: The University of Chicago Press, (1975).

Ravetz, J. R., *Scientific Knowledge and Its Social Problems.* Middlesex: Penguin Books, (1973).

Scherer, F. M., "Firm Size, Market Structure, Opportunity and the Output of Patented Inventions," American Economic Review, 55 (December 1965), pp. 1098–1125.

Shannon, C. E., and Weaver, W., *The Mathematical Theory of Communication.* Chicago: The University of Illinois Press, (1949).

Simon, H. A., *Models of Man.* New York: John Wiley and Sons, Inc., (1957).

Simon, H. A., *The Sciences of the Artificial.* Cambridge, Mass.: The M.I.T. Press, (1969).

Teece, D. J., *The Multinational Corporation and the Resource Cost of International Technology Transfer.* Cambridge, Mass: Ballinger, (1976).

Williamson, O. E., "HIerarchical Control and Optimum Firm Size," *Journal of Political Economy*, Vol. 75 (1967), pp. 123–138.

Williamson, O. E., *Markets and Hierarchies: Analysis and Antitrust Implications*. New York: The Free Press, (1975).

Woodward, J., *Industrial Organization: Theory and Practice*. London: Oxford University Press, (1965).