Journal of Management Studies 40:8 December 2003
0022-2380

Knowledge Levels and their Transformation: Towards the Integration of Knowledge Creation and Individual Learning*

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ABSTRACT This paper shows the link between knowledge creation and individual learning, and the coherence that exists between the knowledge creation view and single and double-loop learning models. It does so by examining differences in levels of knowledge and their relationship with creativity and knowledge creating behaviours. The analysis shifts the focus from the abstract notion of tacit knowledge to a more specific discussion on creative human cognition. The paper is unique in adopting an endogenous perspective to the analysis of individual learning. The analysis is distinct from previous discussions on knowledge creation in three ways: (a) explicit and tacit knowledge are analysed in terms of the nature and degree of inter-dependence that exists between the two; (b) knowledge levels are defined in terms of their applications rather than as abstract concepts; and (c) a distinction is made between shifts and movements in knowledge to separate, and subsequently integrate, the information processing and creative dimensions of learning. Further, the paper highlights specific challenges and limitations/costs that are associated with the transfer/acquisition of knowledge levels, and argues that in the absence of a conscious effort, knowledge levels are acquired through mistakes and failures. Following that, various theoretical and managerial implications to facilitate knowledge creation are discussed.

INTRODUCTION

The knowledge creation view (Nonaka, 1991, 1994; Nonaka and Takeuchi, 1995) predominantly adopts an organizational perspective to the analysis of knowledge creation. Indeed, this perspective is important as new knowledge contributes to organizational competitiveness. However, knowledge creation cannot be viewed as

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separate from individual learning. The absence of such focus makes it difficult to inter-relate action and knowledge, or address the issue of Cartesian subjective-objective split (Easterby-Smith et al., 2000). As a result, much as the role of tacit knowledge in innovation is highlighted (Howells, 1996; Lam, 2000; Nonaka, 1991), knowledge creation is likely to remain largely privatized. This paper examines the link between knowledge creation and individual learning in an attempt to integrate the two.

Following the need to stretch the analysis beyond two levels (Huff, 1997), the paper extends Argyris and Schön's (1978, 1980) single and double-loop models to examine larger differences in knowledge levels, and their relationship with cognition and behaviours which facilitate knowledge creation. The paper is unique in adopting an endogenous perspective to the analysis of individual learning. The analysis is distinct from previous discussions on knowledge creation in three ways. First, in contrast to the 'either–or' approach of the knowledge creation view, explicit and tacit knowledge are examined in terms of the nature and degree of inter-dependence that exists between the two. Second, knowledge levels are defined in terms of their applications, and the equivalence that exists within these, rather than as abstract concepts. Finally, the cognitivists' view on knowledge creation is extended with the distinction between shifts and movements in knowledge to separate, and subsequently integrate, the information processing and creative dimensions of learning. Further, the paper discusses how knowledge levels are internalized and externalized, and by stretching the analysis to multiple levels, magnifies the problems associated with their acquisition/transfer. In doing so, it supports the claim advanced by Cheng and Van de Ven (1996) that innovation and chaos are inter-twined. The paper concludes with various theoretical and practical implications to facilitate knowledge creation.

内源性的观点进行分析

相互交错的

Learning in this paper is defined as the process of gaining knowledge about cause and effect relationships, and the external effects on (Shrivastava, 1983) and of these relationships. The unit of analysis in this paper is the individual. The discussion is mainly focused on the epistemological dimension of knowledge creation. Detailed discussion on the ontological dimension of knowledge, or individual versus organizational knowledge creation, is beyond the scope of this paper, and so is the discussion on eugenics or IQ/EQ. The approach adopted in this paper is analytical and explanatory, as well as prescriptive. The first section of the paper provides a review of the relevant literature. The second classifies knowledge levels, and shows how these generate depth and creativity in understanding. The third section presents various benefits of knowledge levels in terms of reducing learning costs/dependency, affecting behaviours/attitudes, and their transformative effects. The fourth section examines the costs and limitations associated with the internalization and externalization of knowledge levels, and how these can be minimized. The final section presents the conclusion and implications.

在引言部分说明整篇文章的结构

REVIEW OF THE LITERATURE

Definition of Knowledge

Knowledge is defined in different, and often controversial, ways. One set of definitions distinguishes it from information. Information is the conversion of unorganized sludge of data (Davis and Botkin, 1994) into relevant and purposeful information (Drucker, 1998; Jones, 1995). Knowledge is the subjective storage of aggregate information (Strydom, 1994) or expertise (Machlup, 1984). Another set of definitions appears in the form of objective–subjective controversy, or the ontological realism versus epistemological relativism debate in philosophy. Knowledge in the traditional epistemology is equated with intransitive and objective 'truth'. It is believed to exist in its absolute, static and non-human forms. In contrast, knowledge in the modern epistemology is viewed as the process of 'justifying personal belief' in pursuit of truth (Nonaka, 1994). Knowledge is considered relative, transformable and historically transient (Lawson, 1997).

知识被认为是相对的、可转化的和历史短暂的

The objective–subjective divide tends to converge if knowledge is analysed in terms of its levels. *The Oxford Dictionary* (2000) defines level as the amount, standard, point of view, height, floor, or rank in scale or size of importance that exists in a particular situation at a particular time. Towards the objective–subjective convergence, knowledge in this paper is defined both in terms of its product and process dimensions. Knowledge as a product refers to 'levels of objective truth', and as a process to the 'subjective and relative exploration' of these levels. This definition makes a critical distinction between the ontological 'existence' and the epistemological 'availability' of objective truth. The highest level of such truth is absolute in nature. However, while it may 'exist', its underlying essence, as detailed later in the discussion, is not 'explicitly available' for subjective comprehension. What is most explicitly available is the lowest level of objective truth, i.e. the everyday reality. In between the two, there exist different levels of objective truth with differences in levels of explicitness. Consequently, knowledge for a subject is the process of exploration. It is relative as the comparison of the intransitive and transitive dimensions of truth (Bhaskar, 1986; Lawson, 1997) allows the underlying essence to be explored. The intervening variable in the process is human understanding. As subjective knowledge progresses to higher levels, the otherwise less explicit levels of objective truth begin to emerge, leading to a convergence between objectivity and subjectivity. In the discussion which follows, the term 'level' is used to refer to the objective/ontological dimension, whereas the term 'knowledge level' refers to the subjective/epistemological dimension of truth.

知识可以从在成果和过程两个方面上分析知识的定义。从成果上看，客观事物的水平，从过程上看，主观的和相对的探究

讨论中所指的水平是客观/本体上的方面，本文中知识水平是指对事物主观认识上的方面

Explicit versus Tacit Knowledge

Following Polyani's (1966) distinction between focal and subsidiary awareness, knowledge is often distinguished between its explicit and tacit components. Explicit

knowledge is the hard, codified data (Nonaka, 1991), or formal and structured knowledge (Kim, 1993). It can be aggregated at a single location (Lam, 2000), and is stored in organization's routines, procedures, practices, know-how and conduct (Leroy and Ramanantsoa, 1997). In contrast, tacit knowledge refers to the highly subjective insights, intuitions and hunches (Nonaka, 1991), and the accumulated skills and experience (Leroy and Ramanantsoa, 1997). It is person-embodied and ingrained (Chesbrough and Teece, 1996; Howells, 1996; Lall, 1985) and difficult to be formalized, organized (Kim, 1993; Leroy and Ramanantsoa, 1997), or aggregated at a single location (Lam, 2000). Tacit knowledge is recognized to play an important role in technological innovation (Howells, 1996), sustaining a firm's competitiveness (Winter, 1987), or the success of Japanese enterprises (Nonaka, 1991). However, the critical element within tacit knowledge which allows new knowledge to be created remains unspecified.

The explicit–tacit distinction is weak in terms of its scope and perspective. It inadequately incorporates the differences in levels within the tacit and explicit components. The analysis of tacit knowledge, as explained later in terms of levels of learning, has rarely shifted beyond two levels. Likewise, explicit knowledge is mainly understood in terms of its highest level of explicitness, i.e. knowledge which is formalized and codified. Knowledge which is articulated verbally (Hedlund, 1994), such as views and opinions which are vital to an organization's functioning, or that which is not formalized or verbalized but can be demonstrated non-verbally, is ignored. What is also ignored is that there may exist levels within the hard codified knowledge, in that, some codified knowledge is more explicit in conveying the underlying meaning compared to another. Part of this weakness stems from the lack of individual-specific focus to analysis. It results in tacit and explicit knowledge being viewed as independent phenomena, with insufficient analysis of the nature and degree of inter-relationship that exists between the two.

Organizational Knowledge Creation

The knowledge creation view considers that new knowledge is created through dynamic interactions between explicit and tacit knowledge (Nonaka, 1991, 1994; Nonaka and Takeuchi, 1995). Explicit knowledge is relatively easy to be transformed. It is acquired through practice, repetition, reinforcement, imitation, socialization (Leroy and Ramanantsoa, 1997), or logical deduction and formal study (Lam, 2000). In contrast, tacit knowledge is difficult to be codified (Leroy and Ramanantsoa, 1997). It is transmitted through 'metaphorization' (Nonaka, 1991), or 'learning histories' (Kleiner and Roth, 1997) and internalized through immersion (Baumard, 1999), assimilation (Kim, 1993), experience and trial-and-error (Leroy and Ramanantsoa, 1997), learning-by-doing (Lam, 2000), and observation, imitation and practice (Nonaka, 1991). Critical to its internalization is the active involvement of individuals in the 'context' (Nonaka, 1994), and a close interaction

among the knowing subjects (Lam, 2000). Nonaka (1991) uses the explicit–tacit distinction to present four sequential patterns of knowledge-creation: (a) tacit-to-tacit, where existing tacit knowledge is converted into new tacit knowledge through the process of 'socialization'; (b) tacit-to-explicit, where tacit knowledge is transformed into explicit knowledge through the process of 'externalization'; (c) explicit-to-explicit, where existing explicit information is re-shaped into new explicit knowledge through the process of 'combination'; and (d) explicit-to-tacit, where explicit knowledge is transformed into tacit knowledge through the process of 'internalization'.

The knowledge creation view, however, is inadequately integrated with individual learning. It ignores the relationship between action and knowledge, and could perpetuate the Cartesian subjective–objective split (Easterby-Smith et al., 2000). Moreover, as the differences in levels within the explicit or tacit component are ignored, it cannot account for those in transformative effects of new knowledge. Also, if such levels are incorporated in the analysis, Nonaka's knowledge creation patterns, as explained later in the discussion, tend to converge with the traditional communication theories.

Behaviourism and Cognitivism

Organizational learning is often differentiated between behaviourism and cognitivism. Behaviourism observes measurable and controllable behaviours. The underlying assumption is that behaviours are reflexive and predictable, and can be exogenously conditioned (Leroy and Ramanantsoa, 1997) through an appropriate stimulus–response, or S-R, sequence (Borger and Seaborne, 1966). Such sequence is reversed in neo-behaviourism where the expectations of the consequence of a response generate a secondary stimulus for action (Lefrançois, 1972). Behaviourism views learning as passive, adaptive and experiential (Fiol and Lyles, 1985; Levitt and March, 1988; Nelson and Winter, 1982), and emphasizes the notion of 'decision rationality', where individuals change their actions to achieve a given set of outcomes, preferences or goals (Cheng and Van de Ven, 1996). Its individual learning models, however, mainly originate from animal studies in psychology and controlled laboratory experiments (Borger and Seaborne, 1966).

Cognitivism, on the other hand, studies human conduct in terms of mental states (Leroy and Ramanantsoa, 1997) and shifts the focus from response learning to the learning situation (Borger and Seaborne, 1966). The underlying assumption is that behaviours are purposive and unpredictable. Cognitivism views learning as an active phenomenon (Hedberg, 1981), and emphasizes the notion of 'action rationality' (Cheng and Van de Ven, 1996), in which cognitive maps and images are modified or redefined (Argyris and Schön, 1980) and adaptive adjustments are blended with manipulative enactment of environment (Hedberg, 1981). Studies have also attempted to show the complementary nature of learning and

behaviour (Argyris and Schön, 1980; Inkpen and Crossan, 1995; Leroy and Ramanantsoa, 1997). A qualification is, however, introduced that cognitive changes may not lead to an observable change (Huber, 1991) or behavioural outcome (Fiol and Lyles, 1985) in the immediate future (Inkpen and Crossan, 1995). Cognitivism, however, has failed to provide a model of human understanding (Borger and Seaborne, 1966).

Cognitivism also remains insufficiently integrated with knowledge creation. It predominantly equates learning with information processing (Nonaka, 1994). Understanding is seen as a unidirectional process of capturing of the underlying concepts/insights (Argyris, 1976, 1977, 1999; Argyris and Schön, 1978; Fiol and Lyles, 1985) but not how such knowledge is creatively applied. Nonaka's (1994) criticism that cognitivism gives little consideration to the new knowledge that is created from learning is not unjustified.

Shift in the Frame of Reference

Cognitivism inadequately explains the shift in an individual's frame of reference. *The Cambridge Dictionary* (on-line) defines frame of reference as 'a set of ideas or facts accepted by a person which explains [his/her] behaviour, opinions or decisions'. Argyris (1977) refers to it as the 'master program' or the 'theory of action' which involves cognitive rules and reasoning that are used to design and implement actions. Studies have recognized that behavioural learning may or may not alter the frame of reference (Fiol and Lyles, 1985; Kim, 1993). Neither is such shift explained by incremental learning, in which obsolete and misleading knowledge (Hedberg, 1981) of short-term value (Starbuck, 1992) is substituted with new knowledge of long-term value. Changes in the frame of reference, or 'metanoia' (Senge, 1990), are activated due to 'learning why' (Kim, 1993), experimental learning (Leroy and Ramanantsoa, 1997), or double-loop learning (Argyris and Schön, 1978). Double-loop learning, as opposed to single-loop learning which is restricted within the existing 'theory in use', involves the basic questioning of underlying assumptions or governing variables (Argyris, 1976, 1999). Inkpen and Crossan (1995) consider learning as the detection of a mismatch between one's beliefs and perceptions of stimuli, and the modification of beliefs to resolve such mismatch. The exact mechanics of how that mismatch is resolved, however, remains far from clear.

The role of mistakes and failures in learning has remained restricted, or abstract. Studies have regarded mistakes (Dodgson, 1993), problems (Hedberg, 1981), 'creative tension' (Senge, 1990), conflict and disagreement (Nonaka, 1991), turbulence (Inkpen and Crossan, 1995), and failures, crisis and revolution (Argyris, 1977) as mere learning triggers. Other studies indicate an extended role for these in terms of leading to understanding and discovery (Bessant, 1993; Cheng and Van de Ven, 1996; Fiol and Lyles, 1985; Garvin, 1993; Kleiner and Roth, 1997).

However, it remains to be seen as to how mistakes and failures enter into the learning equation to lead to understanding and discovery.

Levels of Learning/Knowledge

Discussions on levels of learning have remained deficient in their scope, perspective and focus. Levels of learning are distinguished in terms of focal and subsidiary awareness (Polyani, 1966), habit-forming and discovery (Hedberg, 1981), or blocked and experimental (Leroy and Ramanantsoa, 1997), lower and higher-level (Fiol and Lyles, 1985), operational and conceptual (Kim, 1993), superficial/survival and deep/genuine/generative (Senge, 1990), and single and double-loop learning (Argyris and Schön, 1978). The analysis, however, has rarely shifted beyond two levels (Huff, 1997) to magnify the advantages (and limitations) of higher levels of learning. Second, levels of learning have mostly been analysed in abstract terms, such as the capturing of governing variables (Argyris, 1999), insights (Fiol and Lyles, 1985), principles (Swieringa and Wierdsma, 1992) or structures (Senge, 1990), but not as to how these are subjectively viewed. As a result, references to 'systems thinking' (Senge, 1990) and integrated learning (Inkpen and Crossan, 1995) are only able to assume but not explain as to how knowledge is subjectively aggregated. Moreover, most discussions shift from one extreme of the learning equation, i.e. the internalization of underlying concepts, to the other, i.e. the levels of transformative outcomes. Single-loop learning is recognized to result in an incremental change, whereas double-loop learning a transformative change in 'theory in use' (Argyris, 1977; Argyris and Schön, 1978). In the absence of a focus on how learning outcomes are achieved (Dodgson, 1993), the differences in levels of learning and those in the transformative effects of new knowledge are difficult to be integrated.

Levels of learning also remain insufficiently integrated with knowledge levels. Argyris and Schön (1978) have integrated single and double-loop learning with know-what/how and know-why, respectively. Quinn et al. (1998) define know-what as the basic mastery of a discipline through training and certification, know-how as the translation of book learning into effective execution, and know-why as the deep knowledge of the underlying cause-and-effect relationships. Levels of learning beyond double-loop, such as deutro learning (Dodgson, 1993; Pedler et al., 1991), which involves learning about previous contexts for learning (Argyris and Schön, 1978), or triple-loop learning, which involves challenging the appropriateness of the underlying purpose or principles (Swieringa and Wierdsma, 1992), do not specify the knowledge level that is achieved, and largely appear as end-states. Similarly, references to 'care-why' or self-motivated creativity (Quinn et al., 1998) and 'will' or 'being' (Swieringa and Wierdsma, 1992), merely represent value or norm systems and not necessarily knowledge conditions. Following the definition of learning given earlier, this paper introduces the possibility of knowledge levels beyond double or triple-loop levels, involving the understanding of higher level

causal links, the transformative effects of which may spill over well beyond the organizational level. To highlight that, the paper analyses differences in levels of knowledge that may exist within the know-why component.

CLASSIFICATION OF KNOWLEDGE LEVELS

Knowledge levels are classified in this paper on the basis of the degree of coherence in an individual's knowledge. An individual's knowledge is at the most rudimentary level if it is cursory and disjointed. Such knowledge has traditionally been referred to as *know-what* and *know-how* to represent its product and process dimensions, respectively. Higher knowledge levels can be explained in terms of a series of trajectories, referred to as *know-whyn*, where *n* represents the trajectory and is denoted by α, β, γ, δ, and so on. These trajectories represent the interface where respective levels of subjective and objective knowledge come into contact with each other. Knowledge is traditionally understood to be developed through inductive or deductive logic. Inductive logic refers to a backward stretch in understanding in which '. . . a general statement, suggesting a regular association between two or more variables, is derived from a series of empirical observations', whereas deductive logic to a forward stretch in understanding in which '. . . a conclusion follows logically from initial premises' (Jary and Jary, 1995, p. 314). The distinction between the two, however, can be better understood in terms of that between a shift of and a movement on a given knowledge trajectory. The subsequent discussion does just that to explain various knowledge levels, and their relationship with knowledge aggregation and creation.

高水平的知识被认为是一系列know-whyn的轨迹

The Shift in Knowledge Trajectory

Knowledge is shifted to a higher trajectory when different levels of objective phenomena are explained by a common denominator. The objective phenomena could represent events, actions, behaviours, time, etc. Likewise, the denominator could be a concept, principle, characteristic, decision, policy, product, etc. Studies have recognized that information is given 'meaning' through the process of 'sense making' (Thomas et al., 1993) or 'interpretation' (Huber, 1991). The shift in knowledge level represents a vertical stretch in meaning/interpretation, in which various objective levels are enveloped within its domain. In the literature on learning psychology, Jerome Burner refers to the process of 'categorization' in which different objects/events are grouped into classes based on their underlying equivalence, rather than their apparent uniqueness (Lefrançois, 1972). This paper extends that process to incorporate the understanding of the equivalence which exists inter-classes, rather than just that which exists intra-class. This is similar to Sparrow's (1998) definition of 'systems thinking' which involves the identification of how various elements, that we might perceive as different, relate to one another. This paper, however,

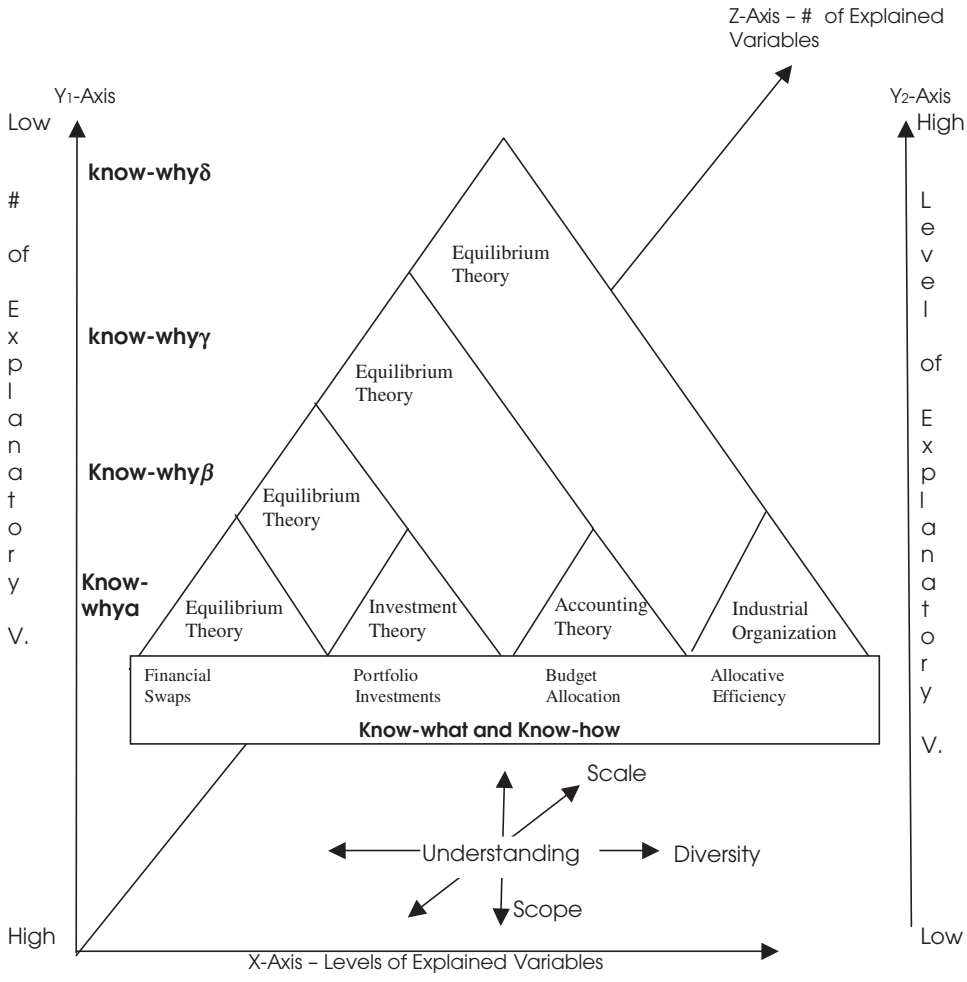

Figure 1. Differences in levels of knowledge

translates such thinking into specific knowledge condition(s) which allows the articulation of the level at which the systems understanding is likely to exist.

To illustrate, Figure 1 takes the levels of explained variables along the X-Axis, and the number of explanatory variables along the Y_1-Axis. The pyramid denotes human understanding, with its three dimensions of diversity, scale and scope. The shift in knowledge level represents the effective reduction in the explanatory base at different objective levels. Such shift, as explained later in the discussion, is necessarily inductive, in that, the understanding travels from the explained to the explanatory. At the most rudimentary level, knowledge is retained as discreet and independent entities. For instance, a finance graduate is likely to be aware of financial swaps, portfolio investments, budget allocation, and allocative efficiency. Know-whyα is achieved when the theory and practice of one or more of these are inter-related, but independent of one another. The greater the number of

phenomena which are understood as such, the more diversified is the knowledge at the α-level. Know-whyβ is achieved when the degree of independence within know-whyα is reduced. For instance, financial swaps and portfolio investments, representing two different objective levels, i.e. *individual* and *group* of securities, respectively, are seen as explainable by the equilibrium theory. Similarly, a shift to know-whyγ is achieved when budget allocation among different *organizational* units, and to know-whyδ when allocative efficiency within an *industry* are also reduced to the equilibrium theory. The smaller the number of explanatory variables relative to the levels of explained, the higher is the achieved knowledge level. Such upward convergence generates greater depth in understanding and broadens its scope to allow knowledge to be aggregated.

这样向上融合生成更大深度的理解和扩大对知识聚合的范围

Movement on a Knowledge Trajectory

Knowledge moves on a given trajectory when the internalized knowledge is creatively applied. It represents a horizontal stretch in understanding where the explanatory domain of the common denominator is further expanded. Such stretch is deductive in nature, in that, the understanding travels from the explanatory to the explained. To illustrate, Figure 1 takes the number of explained variables along the Z-Axis, and the levels of explanatory variables along the Y_2-Axis. At know-whyα the stretch of understanding is narrowly confined, such as the application of equilibrium theory in Finance to the determination of stock, commodity or future prices. With shifts to higher knowledge levels, the entire frame of understanding is vertically stretched. As a result, understanding is able to simultaneously move at different trajectories, and more importantly, inter-relate these within the process. For instance, at know-whyβ the equilibrium theory is applied to similar other individual and group phenomena, such as an individual's defensive behaviour/attitude, as explained in the subsequent section, and group think, respectively, or at know-whyγ to organizational defensive behaviour such as monopolistic activities, or at know-whyδ to an industry's defensive behaviour, such as cartel formation. The larger the explanatory domain of a given variable, the greater is the scale of applications. Such understanding allows new knowledge to be created by inter-relating apparently unique phenomena in what Nonaka (1991) terms as the process of generating analogies. Along higher knowledge levels, the scale gets increasingly diverse. Consequently, the analogies that are made are likely to lead to a higher degree of creativity.

To clarify further, unlike objective levels, knowledge levels are not static and independent entities. These represent the vertical distance that the understanding is able to cover at a given point in time. This argument has a number of implications. First, a higher level concept, for instance, is one which is applicable to several different objective levels. However, whether or not it is understood as such depends upon the number of levels that are enveloped by human understanding. In other words, a

given concept could be a part of know-whyα at one point in time, and know-whyβ at another. Second, knowledge levels are not physical assets which once achieved are perpetually owned. These are retained as long as the understanding is able to switch back and forth between/among different levels. With repeated use over time, an individual's theory of action gets routinized within (Argyris, 1991), which may limit his/her ability to stretch the understanding. Specialization has been known to reduce versatility and flexibility (Starbuck, 1992). Consistent with the observation that higher knowledge levels can exist at any organizational level (Fiol and Lyles, 1985), such an individual would represent a case of lower knowledge level at a higher objective level. By arguing that, the need for learning to be continuous (Argyris and Schön, 1980; Davis and Botkin, 1994; Dodgson, 1993) is further strengthened. Related to that is the argument that the stretch of understanding could be upwards or downwards, depending upon the level at which the individual is placed. For instance, a CEO needs to be able to shift understanding downwards to visualize the impact of his/her decisions at the level of a division, department or an individual, in order to retain the essence of the level which he/she occupies.

BENEFITS OF KNOWLEDGE LEVELS

Knowledge levels provide a number of benefits. These benefits are not just mutually reinforcing within a given level, but also between/among levels. In terms of knowledge creation, these can be analysed at three different levels: reducing learning costs and dependency, affecting knowledge creating behaviours/attitudes, and the transformative effects of new knowledge.

知识水平的好处有三点：减少学习代价和孤独感，影响知识创生行为和态度，对新知识转化的影响

Reduction in Learning Costs and Exogenous Dependency

Learning costs are reduced with shifts to higher knowledge levels. Know-what and know-how are aimed at generating a particular outcome or level of performance (Fiol and Lyles, 1985). These may or may not involve significant information overlap with new knowledge. In contrast, know-why is conceptual and generic in nature. It is likely to involve greater 'redundancy' or information overlap with new knowledge, especially if the novelty is apparent but not conceptual. Information redundancy has been recognized to generate commonality of understanding among employees (Nonaka, 1991). This paper, however, points to the redundancy which is endogenous in nature, i.e. originates from within the learning process. Such redundancy reduces the learning effort [or Labor (L)] and information costs [or Capital (K)] in understanding new knowledge. The reduction in L gives rise to 'learning agility', which is recognized by Williams (1997) as important for a meaningful change. With simultaneous reduction in K, learning costs are greatly reduced. As knowledge progresses to higher trajectories, the information redundancy increases not just at a given level but also between/among levels, leading to exponential reductions in L and K.

Viewing from another dimension, knowledge levels reduce exogenous dependency in learning. Adaptive learning is recognized to be situated in nature (Tyre and von Hippel, 1997). While it can be augmented with additional learning, an exogenous stimulus which is formal and structured, such as training, is likely to be required. Such learning has traditionally been referred to as passive (Fiol and Lyles, 1985; Levitt and March, 1988; Nelson and Winter, 1982). Know-why, on the other hand, is relatively less situated or contextual. For further learning, the need for exogenous stimulus is likely to be reduced, though not eliminated. Learning in this case reflects as less passive. With shifts to higher knowledge levels, the elasticity of understanding is increased, whereby the thinking spectrum can be stretched or contracted to make subtle distinctions in less or more explicit forms of knowledge. Consequently, the degree of passive orientation and the dependence on formal stimulus progressively reduces.

Behavioural and Attitudinal Reflections

Knowledge levels also provide the basis to explain defensive, or otherwise, behaviours and attitudes. The underlying assumption is that such behaviours/attitudes are 'rational' transactions. Knowledge is considered as a source of power (Kim and Mauborgne, 1997) or livelihood. If the individual's knowledge is restricted to, or with the development of routines and habits, ends up at a level lower than that of new knowledge, the power or livelihood base is likely to be threatened. The decision as to whether or not the individual chooses to learn depends upon the benefit–cost relationship of learning *vis-à-vis* that of preserving existing knowledge. With exogenous dependency and learning costs remaining high, as explained earlier, a rational response, *ceteris paribus*, is to erect information entry barriers. Studies have indicated these as primary inhibiting loop (Argyris, 1977), defensive attitudes of specialists (Argyris, 1991), protection of favourable positions (Starbuck, 1992), 'inward looking bureaucracies' (Quinn et al., 1998), and superficial learning (Senge, 1990) and adoption of change (Leroy and Ramanantsoa, 1997). Such responses reduce the scarcity value of new knowledge and allow the benefit–cost relationships of the two choices to be equated. While these responses may enlarge the disequilibrium between environmental changes and subjective knowledge (Lowson et al., 1999), such visualization, consistent with the 'bounded rationality' argument (Simon, 1957), is beyond the ambit of an individual's understanding. Similarly, at lower levels, knowledge is likely to be situated, contextual, and hence a relatively *exhaustible* resource. With every marginal outlay (or sharing) from this resource, the scarcity value of the individual's 'residual' knowledge is increased. The decision as to whether or not the individual chooses to share knowledge depends upon the benefit–cost relationship of sharing *vis-à-vis* withholding knowledge. Under exhaustive knowledge conditions, a rational response, *ceteris paribus*, is to erect information exit barriers. Studies have indicated these as the reluctance

to share (Quinn et al., 1998) accurate information (Argyris, 1977). Such responses externalize knowledge scarcity, and allow the benefit–cost relationships of the two choices to be equated. In situations where mistakes are regarded as inefficient (Kleiner and Roth, 1997), such attitudes prevent free rider activity.

Higher knowledge levels generate positive behavioural dispositions which reinforce learning. With reduced learning costs and exogenous dependency, the benefit–cost relationship of learning relative to that of preserving existing knowledge is improved. Willingness-to-learn is likely to shift to a higher level as a result. With the expansion of the knowledge base, the exhaustive nature of knowledge is reduced. The benefit–cost relationship of sharing relative to that of withholding knowledge is also improved as a result. Furthermore, as knowledge progresses to higher trajectories, knowledge creation is endogenized, which makes the individual's knowledge a *renewable* rather than an exhaustible resource. The individual becomes a repository of new knowledge and achieves the status of an institution in his/her own right. In this position, monopolistic advantages are created from sharing rather than withholding knowledge. Consequently, the willingness-to-learn and share knowledge experience geometric shifts. For Nonaka (1991) such disposition is the hallmark of knowledge-creation, where inventing new knowledge is a 'way of behaving' rather than a specialized activity.

Transformative Effects

Knowledge levels also provide the basis to explain the differences in levels of transformative effects of new knowledge. Cognitive changes have been recognized to transform action (Argyris and Schön, 1978). The transformative effects of single and double-loop learning are differentiated on the basis of whether or not these are restricted within an organization's 'theory in use' (Argyris, 1976, 1977). The level of transformative effect stems from the scope that a given knowledge level provides. The scope of know-whyα is limited to a given trajectory. The transformative effects of new knowledge that originates from this are likely to be restricted within an individual's existing goals/constraints or theory in use. Stretching the analysis further, the transformative effects of new knowledge originating from know-whyβ are likely to be experienced at two different levels; in the theory in use at the individual as well as group level. Likewise, the transformative effects from know-whyγ are likely to spill over into the entire organization, or those from know-whyδ, into the industry as a whole.

COSTS AND LIMITATIONS OF TRANSFORMING KNOWLEDGE LEVELS

Nonaka's (1991) organizational perspective to knowledge creation is of limited significance when organizational learning is recognized to stem from individual learning (Dodgson, 1993; Hedberg, 1981; Leroy and Ramanantsoa, 1997; Senge, 1990).

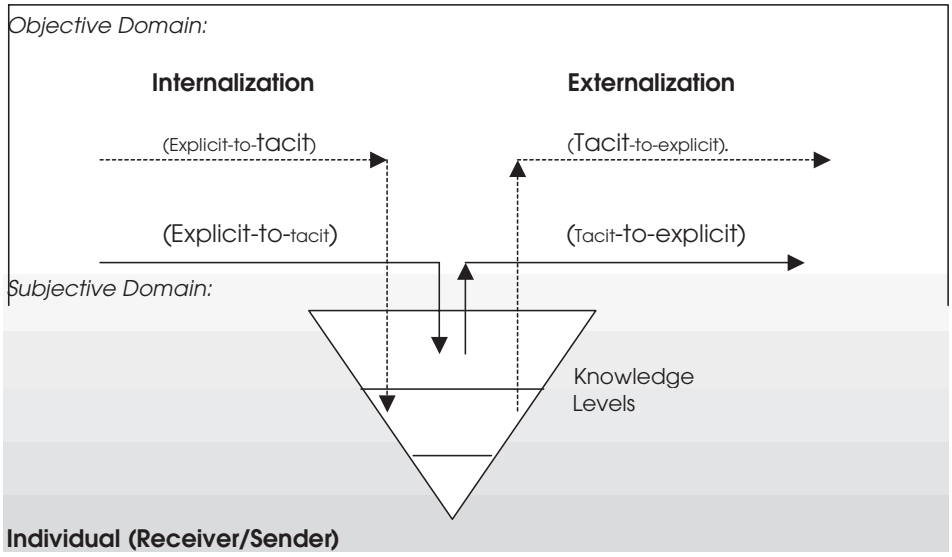

Figure 2. Intra-individual knowledge transformation

隐形知识的转变是有条件的，需要建立在主观政体向客观政体的转变

From the individual-learning perspective, this paper argues that Nonaka's tacit-to-tacit and explicit-to-explicit knowledge creation patterns are not as direct as are considered. As shown in Figure 2, the transformation of tacit knowledge is conditional upon its conversion from a subjective to an objective regime. The higher the knowledge level, the greater is the degree of tacitness, and the lower is the level of explicitness when converted to an objective regime. Similarly, explicit-to-explicit transformation requires the existing explicit knowledge to be understood, i.e. converted into tacit knowledge, before it can be effectively reshaped. In other words, between two individuals, consistent with the sender–receiver models of traditional communication theories, there only exist two real knowledge-creation patterns, i.e. tacit-to-explicit (or externalization) and explicit-to-tacit (or internalization), with differences in levels of explicitness or tacitness within, which are depicted in Figure 2 with different font sizes. The subsequent discussion analyses how knowledge levels are internalized and externalized, and the specific challenges that are faced within these processes.

Knowledge Transformation and the Role of Deviance

To understand internalization and externalization, the underlying stimulus–response relationships of a specific event need to be analysed in-depth. These relationships could appear as stages if viewed in terms of time as the common denominator, or as levels if viewed in terms of the order in which these are ranked. Studies have indicated the S-R relationship between problems and learning (Argyris and Schön, 1978; Baumard, 1999; Shrivastava, 1983) where the former

trigger the latter. To illustrate, consider that to address a given problem the response is to routinize a new framework. Edwin Guthrie's Law of Learning suggests that a response is not a single act, rather a sequence of actions, in which learning involves its association with a combination of stimuli (Lefrançois, 1972). Following that, the action to routinize the framework itself represents an s-R transaction, within the wider ambit of the S-R transaction – hence denoted by a smaller font size. Levitt and March (1988) have highlighted the need to understand as to how routines are developed. The objective to routinize serves as the stimulus (S), and the actual attempt towards that as the response (R). Likewise, the response (R) is also composed of a series of lower level stimulus–response sequences – henceforth denoted as s-r transactions – each representing a successive attempt to establish the routine. These attempts could be an explicit trial, or at a higher knowledge level, a tacit (thinking) effort. The stimulus for such attempts is provided by the deviance that exists between the objective and the trial outcomes. The routine is established when such deviance is reduced to zero. If the routine is unable to address the original problem, a new s-R transaction is enacted, and so on.

Externalization and internalization can be distinguished in terms of: (a) the nature of objective–outcome and stimulus–response relationship at a given level; and (b) the direction in which various stimulus–response levels are generally patterned or cognitively organized. Viewing horizontally, in externalization the objective is taken as given. The stimulus–response transactions are directive, and aimed at aligning the trail outcomes with the objective. In contrast, internalization takes outcomes as given. The stimulus–response transactions are reflective, and aimed at aligning the objective with the outcomes. The need for flexibility of the objective in this case requires a higher level of willingness-to-learn. Studies have indicated this as unlearning (Hedberg, 1981) and relearning based on past behaviours (Fiol and Lyles, 1985). Viewing vertically, in externalization various stimulus–response levels are generally patterned or organized top-down, moving from S-R, through s-R, to s-r transactions. In contrast, internalization involves a bottom-up approach, in which various stimulus–response levels are patterned or organized from s-r, through s-R, to S-R transactions.

Critical to the event is the role of deviance in outcomes. Deviant outcomes not only serve as learning triggers, but, more importantly, also establish new reference points to facilitate comparison. Understanding of causal mechanisms is recognized to originate from contradictory information (Lawson, 1997). Earlier, the literature on organizational learning has remained divided as to whether routines are efficient (Levitt and March, 1988; Nelson and Winter, 1982) or inefficient (March, 1991). Routines are recognized to transform small accidental variations into large stable structures (Weick, 1991) at different levels (Matusik and Hill, 1998), and serve as repositories of knowledge (Lam, 2000). However, their ability to offer deviance is limited, or inexistent. Hence, these are efficient in transforming conceptual knowledge into action, but not action into conceptual knowledge.

Understanding in this case is developed if deviance is consciously enforced, such as through experimentation. However, consistent with earlier suggestions (Fiol and Lyles, 1985; Huber, 1991; Inkpen and Crossan, 1995), such understanding may or may not result in an immediate or observable behavioural change.

Internalization of Knowledge Levels

Knowledge levels are internalized when different degrees of contradictory reference points are compared and reflectively bridged. Know-what and know-how can be developed through a standardized stimulus. Repeated exposure to such stimulus, such as lengthy intervals of successes (Miller, 1994) or stability (Hedberg, 1981), makes knowledge narrow (Cheng and Van de Ven, 1996) and inflexible. It leads to inertial tendencies (March, 1991), reflected as the provision of same responses to different stimuli (Weick, 1991). In contrast, learning under chaotic conditions is an expanding process of discovery (Cheng and Van de Ven, 1996). Knowledge levels are facilitated with an exposure to different degrees of contradictory information, such as for lower knowledge levels, to efficient and inefficient conditions, in whichever order, or for higher knowledge levels, to *highly* efficient and inefficient conditions. As shown in Figure 3, the reference points for know-whyα are not enormously deviating. Such knowledge can be understood with smaller number of s-r

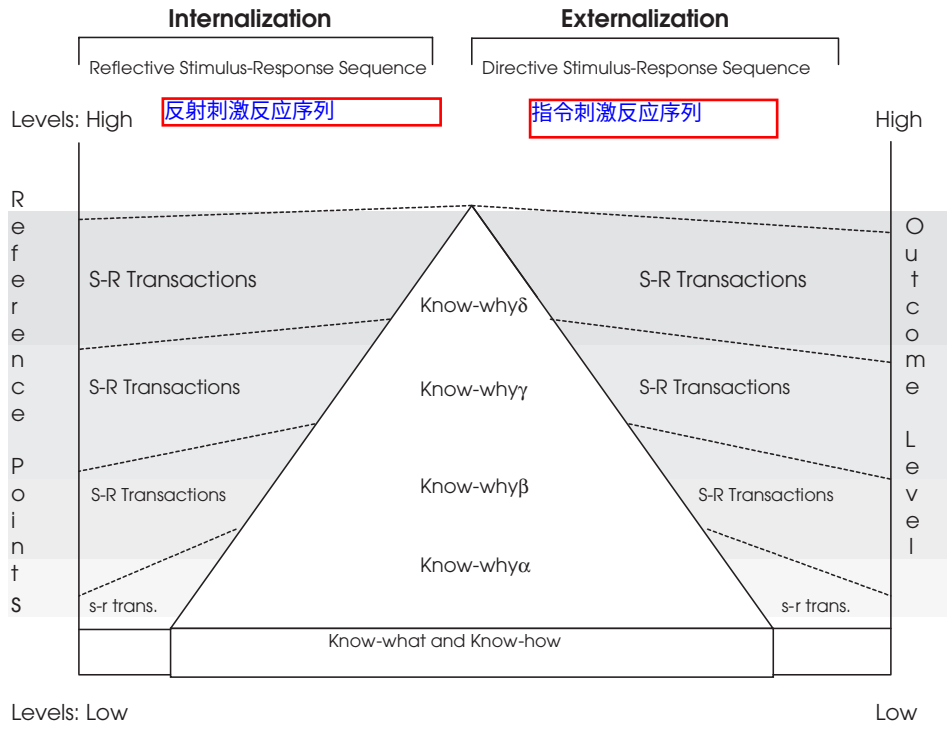

Figure 3. Internalization and externalization of knowledge levels

transactions. Higher levels of objective knowledge, on the other hand, are more complex to understand. The deviance needed to internalize these increases at both ends of the reference points. Consequently, the number and levels of stimulus–response transactions progressively increase along higher trajectories. The larger the deviance between the reference points, the greater is the accumulated sum of stimulus-response transactions at different levels, and hence the more in-depth is the understanding.

Learning costs are, however, reduced if reference points are obtained gradually. Too much turbulence (Fiol and Lyles, 1985) could be dysfunctional to learning (Hedberg, 1981). A gradual exposure complements subsequent shifts by reducing the levels of stimulus-response transactions at a given point in time. The absence of such preceding shifts could result in confusion (Kim and Mauborgne, 1997) or may not result in a cognitive change (Starbuck, 1992) as the grossly magnified deviations could fall beyond the ambit of an individual's willingness-to-learn. Also, as knowledge levels complement each other to reduce learning costs, such complementarities are lost if knowledge becomes stagnant at a given level.

Externalization of Knowledge Levels

The externalization of knowledge levels is also not easy. In contrast with know-what and know-how, which are relatively standardized and easy to be codified (Lam, 2000; Leroy and Ramanantsoa, 1997), knowledge levels are less standardized and tacit in nature. The difficulty in transferring tacit knowledge (Kim, 1993; Nonaka, 1991) is augmented by language constraints which knowledge levels are faced with (Walker, 1962). Consequently, as shown in Figure 3, the number and levels of stimulus–response transactions needed to externalize knowledge levels progressively increase along higher trajectories. More importantly, Figure 4 shows that upon externalization what remains for the recipient is the routine in its explicit form. What is lost in the explicit nature of routine are the underlying stimulus–response transactions upon which the routine is internalized and externalized. 'Best-practice' write-ups are unable to transmit hidden logics and struggles (Kleiner and Roth, 1997). Order and disorder, or form and chaos are embedded within complex systems (Lowson et al., 1999) and are only aggregated cognitively. In other words, both information and explicit knowledge, being objective measures, are poor carriers of knowledge levels. Information in the absence of know-how behind it is insufficient to effect cognitive change (Starbuck, 1992). Consequently, the underlying stimulus–response transactions need to be inductively regained through the process of relative exploration.

Exogenous Limitations to the Transformation of Knowledge Levels

Knowledge levels are underprovided by the market. In view of their tacit nature, coupled with language constraints and the loss of underlying stimulus–response

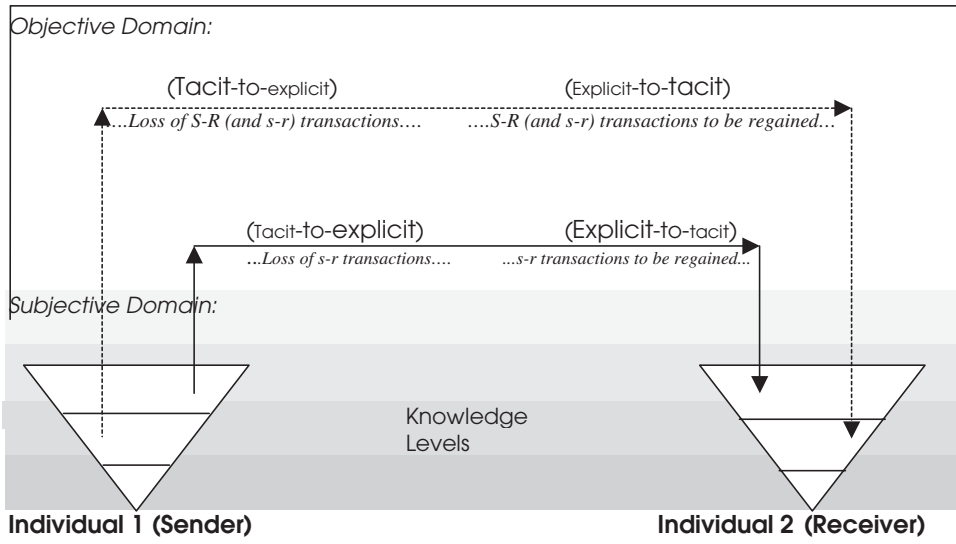

Figure 4. Inter-individuals knowledge transformation

levels upon codification, knowledge levels are mainly regarded as independently existing objective entities. Consequently, their benefits appear to be inversely related, and costs directly related, along higher trajectories. Table I shows that know-what and know-how can be externalized at an enormous scale and apparent novelty. In contrast, knowledge levels have limited apparent scale or novelty to offer. Second, know-what and know-how offer immediate and equilibrating benefits (Fiol and Lyles, 1985). In contrast, knowledge levels are generic and disequilibrating in the short-term, and have distant benefits. In terms of costs, know-what and know-how are easy to be developed and transferred. In contrast, knowledge levels are difficult to be internalized or externalized, and hence developed or transferred. Finally, know-what and know-how are situational in nature. Their development costs can be specifically allocated. In contrast, the costs of developing knowledge levels are difficult to be allocated. Along higher trajectories, such knowledge increasingly gets characterized as an endogenous '*public good*' where there exists 'non-rivalry' and 'non-excludability' in its applications. Hence, it is not surprising that most organizational training remains basic and mechanistic, rather than creative (Quinn et al., 1998) with superficial relationship with learning (Antonacopoulou, 2001).

The under-provision of knowledge levels makes learning private and costly. Learning has been recognized as a largely private affair (Kleiner and Roth, 1997). In the absence of a conscious effort, knowledge levels are exogenously inflicted through various levels of disequilibria, such as mistakes and failures. The reference points for know-whyα are less costly to be obtained. These are inflicted by lower level disequilibria states, such as mistakes, errors, confusion, etc. The reference

Table I. The under-provision of knowledge levels

在应用水平、应用范围、提出创新的可能性、短期价值、长期价值

Benefits	*Know-what and know-how*	*Know-why*α	*Know-why*β	*Know-why*γ	*Know-why*δ
Apparent scale of applications	Highest	Relatively high	Relatively low	Low	Extremely low
Scope of applications	Low	Relatively low	Relatively high	High	Highest
Potential to offer novelty	Enormous	Considerable	Low	Insignificant	Very little
Short-term benefits	Immediate and equilibrating	Relatively less immediate and non-equilibrating	Relatively distant and disequilibrating	Distant and disequilibrating	Extremely distant and enormously disequilibrating
Long-term benefits	Very little	Reasonable	Extensive	Far-reaching	Across-the-board

隐形水平、语言限制、整理的结果

Attributes	*Know-what and know-how*	*Know-why*α	*Know-why*β	*Know-why*γ	*Know-why*δ
Degree of tacitness	Low or inexiste nt	Tacit and person-embodied	High degree of tacitness	Higher degree of tacitness	Highest degree of tacitness
Language constraints	Low or inexiste nt	Relatively low	Relatively high	High	Very high
Result of codification	Objectivity retained as levels are inexistent	Underlying s-r transactions are lost	Underlying stimulus–response levels are lost	Loss of underlying stimulus–response levels is huge	Loss of underlying stimulus–response levels is enormous

外化、内化、开发成本、成本分配

Costs	*Know-what and know-how*	*Know-why*α	*Know-why*β	*Know-why*γ	*Know-why*δ
Externalization	Easy as knowledge is standardized	Costly as directive s-r transactions are involved	Difficult as the no. and levels of directive stimulus-response transactions increase	More difficult as no. and levels of directive stimulus-response transactions are huge	Most difficult as no. and levels of directive stimulus-response transactions are enormous
Internalization	Requires simple retention	Costly as reflective s-r transactions are involved	Difficult as the no. and levels of reflective stimulus-response transactions increase	More difficult as no. and levels of reflective stimulus-response transactions are huge	Most difficult as no. and levels of reflective stimulus-response transactions are enormous
Development costs	Low	Moderate	Substantial	Extensive	Enormous
Cost allocation	Easy as applications are situation-specific	Less easy as situation-specificity reduces	Relatively difficult due to its endogenous public good character	Extremely difficult due to its endogenous public good character	Practically impossible due to its endogenous public good character

points for higher knowledge levels, however, are more costly to be obtained. These are inflicted by higher level disequilibria states, such as conflict, turbulence, failures, and crisis. While such failures may prove 'productive' in terms of leading to insight and understanding (Garvin, 1993), they possess the danger of leading to 'fear of fear of failure' (Argyris, 1991). More importantly, if learning remains privatized,

the scale economies from sharing this resource are lost. Learning from experiences of others (Weick, 1991) clearly provides an efficient alternative.

CONCLUSION AND IMPLICATIONS

This paper demonstrates the link between knowledge creation and individual learning. It argues that knowledge creation originates from an individual's knowledge levels, and that such levels are difficult to be acquired or transferred. Earlier, the knowledge creation view (Nonaka and Takeuchi, 1995) has remained detached from individual learning. It ignores the relationship between action and knowledge (Easterby-Smith et al., 2000), which serves to privatize knowledge creation. It is also weak in addressing the Cartesian subjective–objective split (Easterby-Smith et al., 2000), or to explain the differences in levels of transformative effects that new knowledge generates. The discussions on levels of learning (Argyris and Schön, 1978; Fiol and Lyles, 1985; Hedberg, 1981; Kim, 1993; Leroy and Ramanantsoa, 1997; Senge, 1990) have rarely shifted beyond two levels (Huff, 1997) to allow such integration, and remain abstract in explaining human understanding. This paper provides a coherent basis to integrate learning and knowledge creation. It argues that knowledge levels provide the necessary depth, objectivity and creativity in understanding for new knowledge to be created. Knowledge levels also reduce learning costs and negative behaviours/attitudes which hinder knowledge creation, and generate transformative effects which may extend well beyond the organizational level. The paper further argues that the transformation of knowledge levels is not easy. Following the literature on Critical Realism (Bhaskar, 1986; Lawson, 1997), it demonstrates that knowledge levels are subjectively explored through a comparative analysis of different levels of contradictory information. Such exploration is necessitated by the loss of underlying stimulus–response transactions when knowledge levels are codified. In the absence of a conscious effort, knowledge levels are privately achieved through mistakes and failures. By arguing that, the paper supports Cheng and Van de Ven's (1996) claim that innovation and chaos are intertwined. The paper concludes that knowledge creation can be greatly facilitated by learning from secondary failures, i.e. those of others, rather than primary or self-experienced ones.

The paper has a number of theoretical and practical implications.

Theoretical Implications

The paper argues that knowledge creation is a cognitive condition and that Nonaka's (1991) view of it as a 'way of behaving' is the effect of such condition. With shifts to higher knowledge levels, cognition and behaviours become mutually reinforcing, making the causative factors indistinguishable. By arguing that, the paper also supports the claim advanced earlier that learning and behaviour are

complementary (Argyris and Schön, 1980; Inkpen and Crossan, 1995; Leroy and Ramanantsoa, 1997).

Second, the paper specifies the critical element within tacit knowledge which generates creativity and innovation. Earlier, the discussions on tacit knowledge (Howells, 1996; Lam, 2000; Nonaka, 1991; Winter, 1987) have remained abstract in this respect. The paper argues that innovation is the product of an individual's knowledge levels which allow unique phenomena to be inter-related. It also demonstrates that such innovation, depending upon the knowledge level from which it originates, is likely to offer: (a) greater scale, diversity, and scope; and (b) proprietary advantages as its underlying stimulus–response transactions are difficult to be transferred. Further, knowledge levels generate dynamic effects where future learning and knowledge creation costs are reduced. By arguing that, the paper provides the basis for integrating innovation and competitiveness.

Third, the paper specifies the nature of information or experience which facilitates knowledge creation. Earlier, references to 'variety' in experience (Quinn et al., 1998, Nonaka, 1991), context (Tyre and von Hippel, 1997), and thinking style (Leonard and Straus, 1997) have been unable to identify that. The paper argues that 'variety' needs to be differentiated in terms of that at a given level and that between/among levels. While the former diversifies knowledge, it may or may not facilitate understanding. Knowledge creation is facilitated with variety in *levels* of experience or context which provide contradictory reference points for understanding to take place. 文章强调学习中犯错误的重要性

Fourth, the paper underscores the importance of mistakes and failures in learning. It supports earlier claims in this respect (Bessant, 1993; Cheng and Van de Ven, 1996; Fiol and Lyles, 1985; Garvin, 1993; Kleiner and Roth, 1997) by arguing that mistakes and failures facilitate higher level understanding by providing different levels of contradictory reference points. Hence, these need to be viewed as more than mere learning triggers, rather as 'learning technologies', which need be documented, preserved, shared and, if possible, traded.

Finally, the analysis generates positive spillovers for the importance of rudimentary knowledge. The inherent value of knowledge levels is difficult to be determined as their underlying significance is lost when these are codified. As a result, it is not unusual that most managers prefer visible and identifiable activities (Inkpen and Crossan, 1995). Knowledge levels are and, possibly, will continue to remain under-provided. As an implication, knowledge levels alone are meaningless if these are not translated into tangible and marketable products/services. Know-what and know-how are the prime basis to render such tangibility. In other words, knowledge creation needs to be viewed as a two-dimensional process of explicit-to-tacit and tacit-to explicit which are diagonally opposed, yet consistent with Nonaka's (1991) insight, sequentially related to each other. The agility with which new knowledge is created is determined by that with which an individual is able to switch between the two.

The analysis presented in this paper symbolizes Argyris and Schön's (1980) double-loop model. At one level, the paper argues that knowledge levels allow knowledge to be aggregated and produced. By arguing that, at another level, the paper integrates diverse strands of literature, and, in doing that, creates a new dimension to the analysis of knowledge creation. Following that, the transformative effects of this paper are likely to spill over beyond the knowledge creation sphere. In terms of future research, empirical investigations could relate conceptual learning with deviant information or variety in levels of experience. Other investigations could focus on testing the relationship between knowledge levels and innovation and competitiveness. Theoretical studies could focus on the integration of the ontological dimension of individual and organizational knowledge creation. Further, the demonstration that knowledge levels are difficult to be acquired or transferred provides an indication that passive and active learning may not be either-or situations, rather mere reflections of shifts and movements in knowledge. Also, the paper shifts the focus from learning situation or source *per se* to the nature of information emanating from a given source or situation. By incorporating such objective regime into the analysis, it introduces the possibility that purposive behaviours can be exogenously conditioned with an exposure to higher degree of contradictory reference points. By pointing that out, the paper provides the basis for the integration of behaviourism and cognitivism, which Cheng and Van de Ven (1996) have indicated to be just a matter of time.

Implications for Managers

In terms of practical implications, the paper suggests that institutional prescriptions, such as 'learning organization' (Garvin, 1993; Senge, 1990), 'information-based organization' (Marquardt and Reynolds, 1994), or organizational learning systems (Shrivastava, 1983) are necessary but not sufficient conditions for knowledge creation. Knowledge creation involves 'lean thinking' (Womack and Jones, 1996), which is inherent to the individual. It requires democratic values and norms where 'opposition', 'confrontation' and 'conflict' are seen as productive. It requires openness where defensive attitudes are discarded in favour of sharing mistakes and failures, and divergent perspectives of employees (Leonard and Straus, 1997; Strebel, 1996), especially those originating from lower organizational levels are respected.

The paper also suggests that the adoption of a 'best practice' may only be the 'second best' practice, depending upon the ultimate objective. Best practices are efficient in externalizing knowledge and in solving an immediate problem. However, the fact that these are unable to offer deviance restricts their ability to generate understanding. Hence, these need to be viewed as means to an end, such as the pursuit of the Malcolm Baldridge National Quality Award by Xerox to internalize TQM (Xerox Quality Services, 1993). In the absence of experimenta-

tion and understanding, best practices are likely to substitute the ends, such as the superficial adoption of continuous improvement programmes as found by Garvin (1993).

The paper also suggests that with the increased pace of change in the present-day knowledge era, knowledge levels cannot be avoided, but only delayed. In the absence of a conscious effort, these are ultimately inflicted through primary failures. Such costs can be minimized, if not eliminated, if managers are gradually exposed to different levels of reference points. At the group level, putting together fast and slow-learning individuals (March, 1991) or involving personnel at lower levels in inter-functional, interdivisional and international dialogue (Hedlund, 1994) could serve to achieve that purpose. Likewise, business schools need to reflect a similar heterogeneity in the curriculum and class mix. Further, learning from Matsushita Electric Company's example (Pascale and Athos, 1981) managers can be rotated to work directly in a retail outlet, or performing routine tasks on an assembly line. Beginning from the top (Argyris, 1991) such approach needs to be extended to multiple organizational levels.

NOTE

*The assistance and helpful comments of Dr Yehuda Baruch and Professor Nikolaos Tzokas of School of Management, University of East Anglia, Norwich, and Dr Tony Lawson, Dr Jochen Runde and Dr Matthew Jones of University of Cambridge, England are gratefully acknowledged.

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