A prolegomenon for the investigation of corporate intelligence and its relationship with technology

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Abstract

Psychology recognizes a general factor in human behaviour called intelligence, which affects the level of performance of individuals. It is richly supported by research and theories. With the advent of concepts such as organisational learning the application of individual functions to the organisational level as metaphors to aid understanding is well established. This paper seeks to identify a number of key issues and problems in the application of the concept of intelligence to the domain of corporate behaviour. It also seeks to identify potential roles for ICT (Information Communication Technology) to play in this model. The primary aim is to stimulate further theoretical debate, and empirical research in this area.

Key words: Corporate Intelligence, Spearman, March, Learning, Knowledge

Introduction

A consensus that is still prevalent in science, education and industry is that a general factor, called intelligence, determines people's ability to efficiently solve various problems. This factor manifests itself through several specific forms and they are generally associated with verbal, numerical, mechanical or visuo-spatial abilities. Over the centuries the idea of individual intelligence has been studied extensively, starting with Cicero who coined the term, all the way to Spearman (1904) who formed some major hypotheses that are still widely accepted today. A concept that has received considerably less attention is that of collective intelligence. A subset that is of particular interest to us is the one of corporate intelligence. This paper is a prolegomenon, seeking to identify the key issues needing resolution and the necessary foundational propositions required, if a satisfactory and rigorous theory of corporate intelligence is to be developed. It, therefore, attends to the nature of individual intelligence, learning, knowledge, how individual functions can be applied to groups, and measurement and success criteria for corporate intelligence. Furthermore, it is necessary to identify any fundamental differences between intelligence in organized groups and intelligence at the individual level. Means also have to be developed to avoid reification and the confusion of metaphor or model with ontological levels. This paper also seeks to discover if current developments in information technology enhance the likelihood of the development of successful processes for the achievement of intelligent corporate behaviour. Before we analyse some of the aspects of this phenomenon, it would be beneficial to reacquaint ourselves with some of the fundamental premises of intelligent behaviour.

Intelligence hypotheses

Spearman developed a theory known as the *two-factor theory* that has become the cornerstone of much later work on intelligence, which

hypothesises an identifiable general intellectual ability. The hypothesis states that there exists a general cognitive ability *g,* which is closely correlated with the ability to perform a variety of tasks, and a specific ability *s* that accounts for variation in ability between tasks. The general ability *g* has been equated with an ability called intelligence (Spearman 1904). The greater the ability, or the factor *g*, the better we perform when solving various problems and executing certain intellectual tasks. Following on from this, Spearman's neogenesis concept describes how new rules can be generated on the basis of understanding elements of a problem at hand. He introduced three specific rules (the first being the apprehension of experience) the latter two (which are still recognised as valid today) are called the rules of *eduction* (Spearman 1927). The first form of *eduction* is the eduction of relations and the second one is *eduction* of correlates. The first one states that if one knows the property A and the property B, one can *educe* the relationship between them. The second one states that if one knows the property A and the associated relationship attached to it, one can *educe* a new property (Eysenck and Kamin 1981). These two rules to a great extent, although not exclusively, fall in the category of what Scheffler (1965) calls procedural knowledge. The phrase that describes this type of knowledge is best encapsulated as 'knowing how to' (see also Ryle, 1949). Both critical skills (intellectual capacities) and automatic (routinisable) competencies fall in this category. Knowing how to do something and being able to do it are closely related concepts. Nevertheless, it remains a fact that knowing how is a prerequisite for being able, although being able does not necessarily lead to action, which may be deferred or avoided altogether through risk aversion. This latter premise is particularly relevant in the context of corporate intelligence and the infrastructure necessary to deploy it. A fact examined in depth by March (1999).

Some of the theories (Eysenck and Kamin 1981) differentiate between the so-called intelligence A and intelligence B. Intelligence A is a basic potential, equivalent to Spearman's general factor. Intelligence B is practical realisation of this potential demonstrated through behaviour. Intelligence A is inherited, whilst intelligence B is either enhanced or suppressed. Numerous environmental factors and interactions will determine the degree of intelligence B and the direction it will take. However, Gardner (1983) has developed a theory of multiple intelligences. He initially identified seven intelligences: linguistic, logical-mathematics, spatial, bodily-kinesthetic, musical, interpersonal and intrapersonal. He has subsequently made it clear that there is no logical reason why the number needs to be seven and has in fact identified three new candidates (naturalist, spiritual and existential) (Gardner, 1999). Thus it seems that the jury is still out on the nature of intelligence as something unitary or an amalgamation of complementary and reinforcing abilities. The metaphor of associated and reinforcing capabilities as a foundation for intelligence would seem more promising when developing theories of corporate intelligence as better matching the interdependence of organisational functions and structures than a single, monolithic capability. This image of a capability both integrated but sub-divided also provides a better foundation for the deployment of IT infrastructure to mirror cognitive process at the organisation level.

Intelligence can also be related to deductive reasoning, which is very important from the IT point of view and corporate ability to create infrastructure for enabling intelligent behaviour. As deductive reasoning represents the foundation of expert systems, it is no wonder that expert systems form one of the pillars of artificial intelligence. Equally, categorisation and pattern recognition are two associated elements of intelligence and numerous data mining packages used at a corporate level enable precisely these two elements to be utilised. This paper will evaluate the potential value of such technology in the enabling of corporate intelligence.

Towards theories of corporate intelligence

Some of the elements we mentioned above map naturally into Sternberg's theory of intelligence, which is particularly interesting from the corporate point of view. He defines three aspects of intelligence, namely: componential, experiential and contextual intelligence (Carlson 1990, Sternberg 1988). Componential intelligence includes components such as knowledge acquisition and knowledge processing. Experiential intelligence drives conceptualisation and categorisation, whilst contextual intelligence involves adaptation, selection and shaping. The latter three concepts draw their analogies from evolutionary theory, i.e. the ability to adapt to the environment, select a specific niche and shape it further to suit your needs. These are highly relevant concepts when looking at intelligent corporate behaviour. As some of the elements of intelligence obviously depend on the level of processing taking place, there is no doubt that contemporary ICT provides a more than adequate emulation platform for such a high level of processing. However, intelligent behaviour involves a number of non-conscious rules that go well beyond any technology available today. This implies that the management and employees have a major role to play in deploying such heuristic rules.

If we take this limited subset of properties of intelligent behaviour on a personal level, and extrapolate them on a corporate level, the question is what elements are needed and what their equivalents on a personal level are. How do we define the difference between individual and corporate intelligence? Individual intelligence is, as we indicated above, indirectly inferred by measuring the presence and degree of deployment of several abilities (Gardner, 1983). In other words, an individual either has or does not have certain abilities, or more precisely, they are utilised to a certain degree. A combined degree of utilisation of these abilities is indicated by the intelligence quotient, which is measure on a scale where 100 equals the average for the population. Some of these abilities could be developed, nurtured and stimulated, as indicated above, but major shifts are not possible from one category to another. If we demonstrate certain abilities, we are considered to be intelligent in accordance with a given scale. This intelligence is a predisposition or a capital, figuratively speaking, which might or might not be utilised. Various social and psychological factors will determine if this capital will yield any interest.

On the corporate level, the situation is different. The abilities (different ones from the personal abilities, nevertheless a group of abilities) might or might not be present. However, they could be acquired, or neglected, depending on circumstances. This means that we should be able to measure and establish if certain abilities are present. If they are not, or they are not fully utilised, the indications are that a corporation lacks elements of intelligent behaviour. This, inevitably, brings us in the proximity of knowledge.

Intelligence and knowledge

Whilst intelligence has been the subject of fierce debate, it could reasonably be argued that epistemology is an even thornier field of controversy. It also reflects links to paradigmatic preferences on a number of scales, such as view of science, ontology and human agency (Burrell and Morgan 1979). This paper does not seek to reprise the positivist versus anti-positivist debate, which has bedevilled social science and philosophy for so long. It merely states its assumptions with sufficient justification for a preliminary work such as this. Having done so, the relationship between knowledge and intelligence needs to be examined. Some assumptions are useful in the process.

Assumption One is that: *knowledge is not purely an objective entity*. Whilst it can be presented as a part of a hierarchy such as that of Ackoff (1988), i.e. Data, Information, Knowledge, Understanding and Wisdom, which he sees as "types of content of the human mind", this does not settle its ontological status. Ackoff sees data as symbols and information as description and therefore capable of explicit recording. However he sees knowledge as "know how" (Ryle, 1949) that transforms information into instructions. Thus in some ways it bridges the divide between the objective and subjective, coming as it does after data and information (which are explicit) but before his higher level categories of understanding and wisdom, which are based purely on human cognition (i.e. the tacit ability to identify and correct errors and the ability to make value judgements respectively). Interestingly, his definition of understanding corresponds precisely with that of Bateson's (1972) definition of learning of which more anon. Therefore we can say in line with Polanyi, that knowledge can be both tacit and explicit, both cerebral and tangible (Polanyi, 1966), and that even explicit knowledge needs prior tacit knowledge in order to be understood.

Another fruitful approach is that of Blackler (1995), who identifies knowledge as existing both at the individual and the group level. His categories of embrained, embodied, encultured, embedded and encoded knowledge, similarly span the totally explicit (encoded) to the totally subjective (embrained). Usefully, his categories of encultured and embedded knowledge show how knowledge can reside in collective entities through organizational routines (embedded) and shared belief systems (encultured). This gives clues as to how mechanisms supporting collective intelligence, might work. It also demonstrates the multi-faceted nature of knowledge. The work of Nonaka and Takeuchi (1995) also needs to be examined as further illustration of the dual aspects of knowledge, i.e. as tacit and explicit knowledge. They characterise knowledge creation as a spiral of conversion activity. Knowledge

passes though four phases, socialization, externalization, combination and internalization. It begins as being tacit and is shared through shared work activity, it can then be externalised, combined with other knowledge and finally re-absorbed through internalization. During this cycle, (or "knowledge spiral"), knowledge is grown and innovation takes place. Thus Nonaka and Takeuchi, again link the individual to the collective and the subjective to the objective.

Assumption Two follows from *Assumption One* and states that: *knowledge can be codified and made into an object, but always has a subjective origin and can only be interpreted by a knowing subject*. Thus 'knowing' is a process, which creates its own object. *Assumption Three* is founded on the work of Blackler and Nonaka and Takeuchi cited above. *Assumption Three* states that: *knowledge can operate both at the individual and the collective level*. Having made these assumptions explicit, it is possible to go on to discuss the relationship between intelligence and knowledge. This section seeks to show that this link is via learning. From the previous discussion 'knowing' is an active process by which knowledge about 'states of affairs' (Smith, 1989) is held. The active process by which knowledge is acquired is carried out using sense organs and mental abilities or competences and is also referred to as learning. Intelligence is one such mental ability and is immanent to the process of learning. The higher the intelligence, the more able will the individual be to interpret and process the sense perceptions being received. Now, these abilities can be either genetically determined or they may be learned. It can be argued from the discussion of Spearman (1927) and Scheffler (1965) above that these consist of both innate and learned components. Piaget on the other hand, via his theory of genetic epistemology would argue that it develops as a staged process of maturation based on activity (Rotman 1977).

Building on these views it is possible to begin to define the link between knowledge and intelligence. Knowledge has two aspects, the explicit or encoded and the tacit or cognitive. Both of these require the application of intelligence in order to turn knowledge into productive activity, with desired outcomes. The use of intelligence is necessary, both for the acquisition, creation and deployment of knowledge. It is the essential competence that determines the degree of effectiveness of knowledge. The means by which intelligence brings about the effective acquisition and deployment of knowledge is learning. Scheffler's intelligence B can only be brought about by learning and Nonaka and Takeuchi's innovation cycle (1995) is founded on learning. in this prolegomenon, a definition of learning is necessary. A very influential definition is that provided by Gregory Bateson (1972) it is share by a number of other writers (Engeström, 1987, Dewey and Bentley, 1949, Argyris and Schön, 1978). It defines learning as the systematic identification and correction of error and his concept of the four logical levels of learning is based on the hierarchic classification of the types of error, which are to be corrected. The definition has been developed by such writers as Argyris and Schön (op. cit.) to include in the definition of error as any lack of knowledge, which stands in the way of achieving our desired ends. Having taken this definition into account *Assumption Four* can be stated as: *Knowledge is acquired at both the individual and collective level, by learning and the*

efficacy of this learning is determined by the level of intelligence present. From the four assumptions a hypothesis can be derived, which states that: just as intelligence is intricately involved in individual performance an equivalent factor will be similarly involved in corporate performance. We will call this factor *corporate intelligence*.

Intelligence and corporate performance

From the foregoing it can be seen that in individuals, intelligence exists as way of appropriating and creating knowledge and the process which links the two is learning, defined as the systematic detection and correction of error. Sternberg (1988) makes the informed assumption that learning and the judgemental aspect of intelligence continually interact. This will lead to the development of Scheffler's intelligence B at the individual level. It remains to be demonstrated if an equivalent of intelligence B can be developed at the corporate level. Nonaka and Takeuchi's knowledge spiral (1995) has already shown how individual knowledge can be created and sustained in organized groups. They also posit the working of the spiral in conjunction with an ICT knowledge base. With these conceptual tools and the explicit assumptions, previously enumerated, the remainder of this paper will seek to show how the concept of corporate intelligence, its development and growth, could operate and to suggest ways in which Information and Communication Technology (ICT) could play a crucial role.

If intelligence is understood to be 'adaptively variable behaviour' (Carlson, 1990, Sternberg, Wagner 1986) then learning activity has to play a prominent role in this process. Sometimes learning is closely associated with motivation, but on the individual level it is very often better to perceive learning as an instinctive activity (Stenhouse 1973). This poses a serious dilemma. Individuals learn instinctively, which enables them to adapt to changing circumstances, or to adapt the environment (Sternberg and Wagner 1986). Corporations have no intrinsic instinct for learning, which implies that instincts need to be replaced by motivation, as otherwise the process of learning will never take place on the corporate level. Another major difference is problem recognition. In order to act intelligently, individuals first of all have to realise that they have a problem to solve. Corporations, on the other hand, very often do not even know that they have a problem to be solved. This, coupled with the lack of learning as a reflex (instinctive activity), makes corporations particularly vulnerable as entities. In other words, unlike with individuals, corporate intelligence is not a 'gift', but something that needs to be developed, cherished and continuously nurtured. Similarly corporations have to learn to recognise precisely what intelligent behaviour looks like. March (1999) has identified the main issues associated with this.

March sees organisational intelligence in terms of the ability to achieve desired outcomes of the firm (which fits well with Argyris and Schön's (1978) definition of learning expressed above). However he explains that the assessment of organizational intelligence is highly problematic. The assumption of rational choice is complicated by the existence of ignorance about consequences, which cannot be anticipated precisely, internal conflict

within the organization and ambiguity caused by current preferences not necessarily persisting through time. Next he turns to the paradox of exploration versus exploitation. The preponderance of one over the other and the choice between them is difficult to ascertain and both success and failure can become traps restricting intelligent action. Rational decision-making is severely bounded by imperfect knowledge of alternatives, consequences, preference ordering and appropriate decision-making rules. Decision-making is also affected by risk preferences and March, using mathematical simulations, suggests that success leads to risk aversion and failure to risk taking. He also questions the efficacy of learning from experience as superstitious learning can arise when the reasons for success are wrongly attributed. Learning from powerful others may also be inappropriate, because their situation is different and may lead to erroneous inferences (March, 1999).

Speed of mental processing in individuals is associated with intelligence (Lehrl, S. and Fischer, B. 1988) but March suggests that the efficacy of rapid learning is limited by a lack of suitable experiences to learn from, the fact that ordinary learning leads to stability and a reluctance to experiment and an inability to identify causal relationships. March (1999) also suggests learning from experience is limited by firms taking a short term view, paying too much attention to occurrences near to the learner and paying too much attention to successes and not enough to failures.

Despite these cogent arguments an attempt will be made to identify some possible ways forward. The ways in which the various components are deployed in order to render an individual's actions intelligent, according to current relevant theories, can be presented schematically. The three most crucial components are learning, information processing, motivation and cognitive functions. By cognitive functions, we mean activities such as perceiving relationships, comparing and judging similarities and differences, coding information in a more abstract form, classification, categorisation and retrieval. Sternberg (1988) combines these in a simple schema for *individuals* based on three linkages.

1. Environmental inputs influence motives, which influence intelligent behaviour.
2. Learning abilities influence learning activity, which produces products of learning (e.g. knowledge). These in turn affect cognitive functioning, which affects intelligent behaviour.
3. Information processing abilities condition cognitive function, which as stated above also affects intelligent behaviour.

However, these processes can be used as a powerful model of processes taking place at the *organisational* level. Thus intelligent behaviour at the individual level equates to intelligent corporate decision-making, which is generally a collective function (of the board of directors) although a powerful Chief Executive may attempt to appropriate this function. This dependent variable is the outcome of a number of other variables in the system. Figure 1 illustrates how functions in an individual's psychology can be represented by

corporate functions at the organisational level. *Mission, vision and strategic plans* could replace the function of *motivation* in the individual, as these are the driving force behind the behaviour of the modern corporation. Individual learning and learning abilities in Sternberg's individual schema (1988) are represented in our organisation level model as organisational learning, and organisational learning abilities respectively. The ways in which learning can be achieved at the organisational level are well established in the literature (Argyris and Schön, 1978, Senge, 1990, Kim, 1993). Information processing at the individual level can of course be supplemented at the organisational level with electronic information processing facilities such as: databases, knowledge management tools, data warehouse, DSS (Decision Support Systems), EIS (Executive Information Systems), OLAP (Online Analytical Processing Systems), ERM (Enterprise Resource Management Systems) and CRM Systems. This model therefore demonstrates some possible means whereby organisational intelligence can go way beyond individual intelligence, given the power of modern information technology. This model has been presented to illustrate just one possible model for using individual intelligence as a blueprint for organisational intelligence. The main thrust of this paper, is of course, to identify appropriate problems rather than solutions.

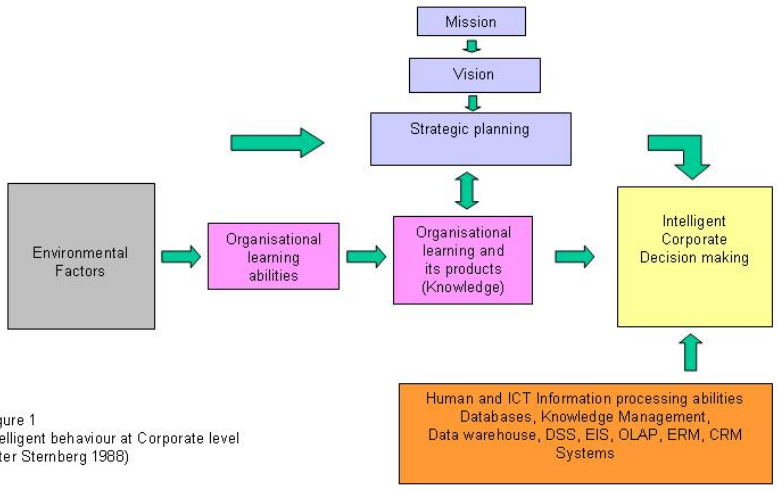

Figure 1
Intelligent behaviour at Corporate level
(after Sternberg 1988)

<Figure 1: Intelligent behaviour at corporate level – After Sternberg 1988.>

Problem solving

Clearly, corporate intelligence can be perceived as adaptable behaviour that solves problems (either the current ones or the anticipated ones) by either changing the way corporations do business, or by changing the environment in which the business is conducted. In this case, a problem-solving mechanism is absolutely essential for demonstration of intelligent corporate behaviour. Bransford and Stein (see Sternberg 1986) offer an acronym IDEAL, for stepwise conceptualisation of problem solving process, which stands for:

I = Identify the problem
D = Define and represent the problem
E = Explore possible strategies
A = Act on the strategies
L = Look back and evaluate the effects of your activities

Most of these steps are associated with the tasks that management is usually commissioned to do in a corporation. Although corporations consist of people, the foundation for corporate intelligence, as examined in this paper, should not be based on individual intelligence of the people employed by the corporation. This individual employee intelligence is a necessary, but not a sufficient, condition for corporations to exhibit intelligent behaviour. Their work can be enormously enhanced by the ICT systems identified above. These can also reduce some of the difficulties identified by March (1999) by dealing with ambiguity, limitations of knowledge, lack of experience etc.

Some studies (Sternberg and Wagner 1986) analysed intellectual competencies of employees (senior managers in particular) and isolated certain generic senior management competencies. Broadly, senior management competencies are defined as the influence competencies, the intellectual competencies and self-confidence. If we exclude self-confidence and the influence competencies (such as the need for power, personalised and socialised power and symbolic influence), then the three key intellectual competencies that were isolated are:

- Planning/causal thinking
- Diagnostic information seeking
- Conceptualisation/synthetic thinking

These competencies are clearly individual, although a corporation demonstrating intelligent behaviour can very easily automate some of these competencies. Specific indicators that define these competencies are:

- Ability to see relationships, alternatives, implications, consequences and casual effects
- Ability to make strategies and break them down to individual steps to achieve goals
- Seeking specific information in ambiguous situations
- Seeking information from multiple sources

- Identifying specifics of the problem to differentiate it from a similar one
- Understanding how different parts, needs or functions of the organisation fit together
- Identifying patterns and series of events
- Identifying most important issues in a complex situation
- Creatively using analogies to understand or explain the essence of a situation

Clearly, the technology can take over some of these functions. This can free the capacities of a competent manager, or potentially enable above average performance of a mediocre manager. This leads us to the point where we need to state that, in order to measure corporate intelligence, we first need to remove individual intelligence of employees from the measurement process.

We need to emphasise that the assumption we make is that on the corporate level intelligence can be equated with the efficiency of tackling new tasks, adapting to new situations, outmanoeuvring your competitors or creating new paradigms. The natural extension of this assumption is that an intelligent company needs to be profitable. From the business point of view it is preposterous to talk about intelligent behaviour, if such behaviour is not demonstrated through reasonable and healthy profits. What is reasonable and healthy is determined in relative terms in accordance with current and specific industry standards. This implies that a company can be profitable (monopolistic position, protectionist measures, riding the wave of recent innovation, etc.), but does not necessarily exhibit intelligent behaviour. The opposite is impossible. If a company is considered to be intelligent, by definition it has to be profitable.

Corporate intelligence

The question now is to determine what abilities need to be exhibited and to what extent utilised for a company to be considered intelligent. And further, how do we eliminate from this equation all the special and circumstantial factors that make it profitable regardless of the presence of such abilities.

If we make analogy with individual intelligence, this task might be more easily accomplished. First of all, if there are no challenges and variations in circumstances, intelligence has no value. Because we are surrounded with variability and constant changes, we use intelligence to solve different problems, or, we initiate improvements that generate further changes and variability. The same applies to corporations. If there were no changes, there would be no possibility of exhibiting intelligent behaviour.

Sternberg (1986) proposed a method of studying intelligence, which he referred to as componential analysis. The first part of this method, called internal validation, involves isolating (and scoring) the information-processing components and strategy used in problem-solving (problem-solving in this context implies cognitive tasks hypothesised to relate to intelligence). The second part, called external validation, involves correlating the scores with

some validated test results (in his case psychometric tests hypothesised to correlate with the target cognitive process). How could this approach be used in the context of corporate intelligence?

One possibility of achieving internal validation, which includes scoring, could be through a development of the time constrained scenario that a corporation has to solve using the infrastructure only (i.e. excluding employee intervention). The external validation would mean using annual accounts, for example, as a substitute for psychometric tests that are used on individual level. This still leaves the problem of eliminating special factors (such as monopolistic position or the presence of protectionist measures) implicitly embedded in annual accounts. Nevertheless, the concept of shaping how to define and measure corporate intelligence is beginning to emerge. The IT infrastructure could be used for benchmarking to improve validation, simulation and mathematical and statistical techniques to eliminate misleading factors in its past performance, and OLAP and ERP systems to help it evaluate its intelligence as a past and present performer.

We are inclined towards a view of corporate intelligence advocating Hebb's intelligence B (i.e. an intelligence which is malleable and subject to development, rather than something fixed and unalterable) and Sheffler's procedural knowledge. It is clear that the complexity, dynamics and the development potential of corporate intelligence exceed by far those of individual intelligence. We also tend to agree that although knowledge is of a subjective origin, through codification it can be turned into an objective category operational on the group (corporate) level. Without intelligent management, this knowledge would never exist in the first place, nor would it be ever turned into an operative and productive activity. In other words, to achieve all three aspects of intelligence, i.e. Sternberg's componential, experiential and contextual intelligence, intelligent management and intelligent corporate infrastructure need to coexist.

Conclusion

The purpose of this paper is to act as a prolegomenon for the definition and measurement of corporate intelligence. Many useful analogies were found in the area of individual psychology. Suitable indebtedness to the work of March (1999) in preventing the underestimation of the problems involved in developing corporate intelligence is acknowledged. Several assumptions were identified and a tentative hypothesis was produced. We hope these will be tested and validated or improved (or criticised and superseded!) by the work of those reading this paper. Our prime intention is to move the debate on. It is clear that we have only identified models and potential metaphors for the development of corporate intelligence rather than allowed ourselves to develop systematic plans for deploying our concepts. Others may wish to go beyond our approach. Although many aspects are still not clearly defined, the progress that has been made with measuring individual intelligence and relating it to a number of other deciding factors is substantial and we have

every confidence that the advances in the field of individual psychology can be leveraged for the study of corporate behaviour.

We do not doubt the importance of the role of ICT in the development of this field of study and have attempted to indicate a number of ways in which it can counteract some of the difficulties faced. As technology advances in the fields of artificial intelligence and data mining even more opportunities to develop meaningful organisational intelligence should emerge.

This prolegomenon intends to point in the direction of this rich source of inspiration and capitalise on it. Specific equivalents of measuring and defining individual intelligence in the context of corporate intelligence need to be developed and constructed. Testing and validating them will be a massive task, as well as putting them in the corporate infrastructural context. However, we feel that this can be as rewarding as it is already long overdue.

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