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Quality Improvement in Knowledge Based Organizations: Capturing Tacit Knowledge to Aid Organizational Learning in Venture Capital Decisions

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Abstract

This paper reports the investigation of methods of quality improvement for tacit knowledge-based processes in venture capital firms. The study found that quality could be improved in investment decision processes through emergence of tacit knowledge (Polanyi, 1966) to balance the requisite variety needed for organizational steering. The methods applied yielded a doubling in decision cycle performance for the venture capital firm under study.

Metrics of information flows provided feedback on performance of knowledge processes, while heuristic cybernetic methods were tested as tools to enable emergent strategizing and organizational learning. Conceptual cognitive mapping was employed to document tacit knowledge and measure the degree of complexity, based on Ashby's (1965) Law of Requisite Variety. Neural net linguistic analysis was utilized to objectify aggregation of concepts in the mapping process to limit subjective bias (Eden, 1983). Ackermann & Eden's (1998) JOURNEY method was used for consensus building to reduce the variety in decision processes.

Key Words

Tacit knowledge, cognitive mapping, decision processes, quality improvement, requisite variety, organizational learning, systems dynamics

Introduction

Knowledge-based organizations, like any other type, operate a value chain (Porter, 1985) of transforming inputs through internal processes to create value-added outputs. Organizations undertake quality improvement programs to align their internal value chain processes to better meet customer expectations. Knowledge-based firms, such as venture capital (VC) organizations struggle to implement quality improvement as their internal processes are typically tacit/implicit and driven by human behavior. It is the premise of this paper that quality improvements in the key value creation processes of knowledge-based organizations are a function of improvements to organizational knowledge management. Quality improvement programs for VC firms must, therefore, be focused on developing and implementing systematic methods of emergent strategizing (Mintzberg, 1989), tacit knowledge management (Polanyi, 1966) and organizational

learning (Senge, 1994) of competencies and capabilities to enable effective strategic adaptation, anticipation and leveraging of the knowledge.

This paper reports on an investigation into a venture capital firm (confidentiality restrictions preclude disclosure of the name) seeking to capture the implicit knowledge of qualitative processes; used by its employees, individually and in teams; to understand and improve upon its competencies. It wanted to make the knowledge and processes explicit and documented so that they could be improved upon, retained and taught. The dilemma they faced was how to accomplish the task of quantifying and improving the quality of their capabilities that were, almost entirely, cognitive assessments and decisions, that leveraged a 'web of beliefs' (Reisberg, 1997), built from years of experience and deep embedded knowledge (Keating, Robinson & Clemson, 1994; Eden & Ackermann, 1998).

Improving quality is generally thought of as a means to reduce the number of defects in manufacturing processes (E.g. Six Sigma Quality™). However, VC firms do not produce quantities of widgets, but rather create value qualitatively in the form of intangible assets, from the knowledge and creativity their employees put in (Handy, 1989). Achieving 99.99966% accuracy in the utilization of intangible cognitive processes sounds like an oxymoron if not a paradox. This apparent contradiction is not unique to knowledge-based firms. Even traditional firms are regularly reporting tangible net assets as representing only 10% to 15% of their value (Lev, 2000). This is because over the past several decades, the production functions of companies have undergone a dramatic shift. Intangible assets are rapidly supplanting physical assets as the major assets that create value and growth.

> *"The difference between asset value and book value is not goodwill, it is core competence — people- embodied skills"* (Hamel & Prahalad, 1996, page 255)

Until an organization is able to make the implicit, intangible and qualitative cognitive processes, that are foundation of their competencies and capabilities, explicit and tangible, they will not be able to learn from their knowledge, value it, restore accountability (Lev, 2000) and leverage it strategically. Despite the recognized strategic importance (Hall, 1992, 1993) of intangible resources, their management is not well known or implemented within mainstream management practice:

> *"Although human resource executives will proudly proclaim that 'people are our most important asset,' there is seldom any mechanism for allocating human capital resources that approaches, in its sophistication and thoroughness, the procedures for capital allocation"* (Hamel & Prahalad, 1996, page 255)

This issue is particularly relevant to the VC industry and especially for corporate VC organizations. Corporate venture capital organizations face continual and regular turnover of their staff because, they can not compete with the pay scales offered by pure financial venture capital firms as that would have their investment professionals (IP's) earning more than the company's top executives. The very high compensation packages offered by private equity firms are a symptom of supply and demand for rare knowledge. While implicit/tacit knowledge processes are often organizational, thus protecting many firms against appropriation by hiring the talent away, knowledge in the venture capital industry is largely individual, making it easy for competitors to raid each other to capture knowledge. Corporate venture capital organizations

have a vested interest in making their employee's knowledge explicit so that it can escape from a knowledge appropriability trap (Grant, 1998).

It is the primary thesis of this paper that traditional quality methods which focus on algorithmic rule seeking optimization of functional operations are not adequate to address improvement and knowledge transfer of the complex fundamental competencies that create value in knowledge based organizations such as VC firms. Heuristic methods, or rules enlightened searching by which one might find 'paths to expand the potential solution space' (Lenat, 1984) can and should also be employed to improve quality of knowledge driven processes. The apparent complexity of the implicit qualitative knowledge capital employed has prevented corporate VC organizations from fully leveraging their key competencies. Management cybernetics would appear to offer methods for problems of quality and strategic viability when dealing with the complexity of tacit individual and organizational knowledge, for cybernetics is:

> *"concerned with exceedingly complex systems: systems so involved that they are indescribable in detail."* (Beer, 1959, page 30)

Quality Improvement in Knowledge Based Organizations

Traditional operations research methods of quality improvement are commonly used to re-engineer production and operational processes in organizations. The strategic applicability of such methods to tacit/implicit business processes is less clear, as knowledge based processes are:

> *"distinguished by their emphasis on precognition and adaptation, in contrast to the traditional emphasis on optimization based on prediction*." (Arthur, 1994, as quoted by Malhotra (1998), page 58)

Porter (1996) questions the value of quality improvement as a means to differentiation, as he presumes that every organization would seek to implement best practices for its sector. Even Hamel & Prahalad (1996, page 15) have claimed that *"quality will no longer be a competitive differentiator; it will simply be the price of market entry"*. The failure of quality to provide a means to differentiation should not be taken as an indictment of the practice of quality. Rather it is a symptom of the failure to develop and apply appropriate quality methods to the core value creation processes.

It should be argued that the likely reason so many organizations have difficulty building differentiation through quality initiatives has been due to the preponderance of focus on quality as it relates only to function operational error reduction of simple probabilistic systems, to the exclusion of it's use in the management and development of strategies and inexplicit knowledge-based competencies.

> *"Optimization in complex adaptive systems is rarely possible, and is often not meaningful."* (Holland, 1998, page 244)

Given that the typical modern firm has on average 80+% of its value in intangible assets, this would appear to be a very ripe area for organizations to focus their quality initiatives on. Organizations will not succeed in bringing quality to their intangible knowledge processes unless they implement systems dynamics based quality methods to manage: heuristic adaptation and precognition, at all levels of the organization, through pattern recognition, model building and

organizational learning to the end of the use & development of key knowledge competencies and strategic decisions.

The key problem facing organizations is how to achieve 'effective utilization' of its intangible assets; the know-how trapped inside the minds of workers around the world in the form of internalized tacit mental models (Mintzberg, 1989; Senge, 1992; Nonaka & Takeuchi, 1995). Leveraging tacit knowledge remains an illusive issue as one must first figure out how to make it explicit in order to improve its use. Tacit knowledge, also known as implicit knowledge or knowledge that is difficult to articulate, has been increasing recognized for its essential role in organizations, because explicit operational knowledge has to be internalized, made tacit, before it can be used in any kind of organizational activity (Raven & Prasser, 1996; Nonaka & Takeuchi, 1995). Knowledge that is difficult to articulate, by definition is not easily shared or distributed within an organization, for as Polanyi (1966) stated, when he first defined tacit knowledge:

> "*we can know more than we can tell*" (Polanyi, 1966, page 4).

Organizations often rely on the Socialization (Nonaka & Takeuchi, 1995) transfer process of mentoring of new employees as a means to train them but if an organization's objective is to reduce training time and limit loss of knowledge capital, the knowledge needs to be made explicit. To emerge tacit cognitive concepts into explicit knowledge a number of researchers (Sveiby, 1999; Nonaka & Takeuchi, 1995; Senge, 1994; and Holland, 1998) have proposed a combination of different methods including model building, metaphors and analogies.

> *"Human knowledge articulated through language is essentially metaphoric in character. "Knowledge about knowledge" is therefore a question of which metaphors one chooses to express one's knowledge in."* (Sveiby, 1999, page: http://www.it-consultancy.com)

Metaphors do not generally come to mind as a quantitative operations research tool for quality improvement, however it is easy to forget that anything that we are capable of quantifying and modeling now was preceded by qualitative judgments. Before we had thermometers, things were either cold, warm, hot, very hot, etc. Deutsch (1966) argues that definitions of quantity and quality might better be developed in terms of the operations from which they are derived: process operations of recognition and measurement.

> *"Quality is recognized, therefore by the matching of two structures. The decisive step is to establish whether or not such matching had occurred. Quantity in this view would appear to be really a more complicated notion than quality. It can be measured only after some qualitative matching has occurred"* (Deutsch, 1966, page 87)

Quality, thus, is educed from simple matching such as in metaphor, while quantity is a second order match. This would appear to confirm Polanyi`s 3rd tenet of knowledge, that tacit is more fundamental than explicit knowledge. Private equity investment decisions are based upon qualitative cognitive assessments of 'emergent phenomena' (Holland, 1998), an appraisal of the potential of an early stage start-up firm to emerge into a 'viable system' (Beer, 1985). Investment decisions involve a process of judging how 'chaos becomes order', in which 'the whole is greater than the sum of its parts'. The use of metaphor as a quality tool for modeling the emergence of complex systems is recognized for:

> *"human creative activity, ranging from the construction of metaphors through innovation in business and government, to the creation of new scientific theories, seems to involve a*

> *controlled invocation of emergence. Emergent phenomena ....occur*[s] *in domains for which we have few accepted rules; ethical systems, the evolution of nations and the spread of ideas* [are ones that] *come to mind"* (Holland, 1998, page 2)

The classic definition of cybernetics, as given by Norbert Wiener (1948) was *"Cybernetics is the science of communication and control in the animal and the machine"* As applied to management, Beer (1985, page ix) defined cybernetics as *"the science of effective organization",* which at its essence implies the need for quality, but could easily be mis-construed as optimization. Cybernetics in respect to the modern organization might be better described as *the science of viable emergence and sustainable dynamic adaptation of self-organizing knowledge systems*. Quality improvement of emergence and adaptation of knowledge processes in complex systems starts from the perspective all organizations can be modeled according to certain fundamental regularities and patterns and that every organization is held together by feedback loops of communication (Deutsch, 1966).

> *"Understanding the origin of these regularities, and relating them to one another, offers our the best hope of comprehending emergent phenomena in complex systems. The crucial step is to extract the regularities from the incidental and irrelevant details. This process is called modeling."* (Holland, 1998, page 4)

> *" To be able to do that, you have to be able to visualize your organization as consisting of nothing but knowledge and knowledge flows."* (Sveiby, www.knowledgecreators.com)[1]

If an organization constrains, blocks or pollutes with noise, the information flows, it will lose the ability to direct itself towards its aims (Ansoff, 1965, 1987) and objectives. Organizations must receive negative feedback, via communication networks, to effect action in answer to an input of information. If feedback is well designed, an organization will be able to learn and converge on its strategic goals and objectives through a series of diminishing, under and over, corrections. Additionally, organizations need systems to filter feedback information to reduce (attenuate) the variety in the network, while in other cases, variety (Ashby, 1965) needs to be amplified so that balance is achieved (Beer, 1985) If the volume of the feedback is inadequate or excessive, the organization will not learn and the system may oscillate into increasing error.

Deutsch (1966) defines three types of learning by feedback principals: 1) simple learning by goal seeking, 2) complex learning by goal modifying feedback and 3) consciousness. Consciousness, as defined by Deutsch (1966, page 98), is "*a collection of feedbacks of secondary messages"*. In essence it is composed of the internal symbols that individuals or organizations develop as interdependent and interactive labels about changes in the state of parts of the system that were initially received as primary messages during simple and complex learning. While this may sound obtuse, he is describing essentially the same relationships between explicit and tacit knowledge as described by Polanyi (1966), Nonaka & Takeuchi (1995) and as 'implicit theories' by psychologists (Getner & Stevens, 1983; Neisser, 1987; Reisberg, 1997). Consciousness then is composed of the tacit mental models that were constructed as meta-messages about the original explicit knowledge, as it was internalized. These internalized mental models are the basis of how organizations adapt to and anticipate change in the environment. They are the basis behind emergent strategizing and organizational learning.

Engineering quality improvements of knowledge processes becomes a design issue of modeling the existing knowledge processes and determining the volume and variety of information flows that are needed at each stage of the learning by feedback process. The critical issue is then: what is the requisite variety (Ashby, 1965) or the degree of complexity that is required in the information system feedback loops to enable effective conscious decision-making and learning? If an organization attempts to operate by limiting the variety of states, inherent to its internal systems (e.g. its computer systems, databases, etc) and its decision processes, to be less than the complexity requirements of its customers, then it will fail to meet their expectations for quality. Likewise if an organization sets up systems that go beyond the requisite variety that is needed, it will succeed in setting up overly bureaucratic operations that are expensively inefficient.

If an organization's knowledge of its processes remains tacit/implicit, then design of information flows cannot be explicitly designed and the organization is at risk of implementing systems that will operate outside of the relevant range necessary for it to operate and sustain itself as a viable system. This may result in the in the system convulsing through oscillations as it attempts decision-making that is either constrained by inadequate, or is overwhelmed by too much, informational variety. Only if these processes are made explicit can the organization succeed in systems designed with requisite variety to enable quality in its emergent strategizing and dynamic adaptive learning.

Heuristic methods for modeling tacit knowledge and developing emergent strategy as tools for quality improvement

Given that quality improvement in knowledge-based firms should be accomplished through heuristic search methods in addition to the traditional quality approaches (algorithm seeking), consideration must now turn to what tools are appropriate to this task. Finding the right tools required a substantial search across a wide body of academic literature as strategic mental models and qualitative knowledge processes are not generally considered part of the domain of continuous quality improvement programs. Firms may employ consultants for "business process re-engineering" with a focus on strategy and change management, but these are typically one-off engagements that tend to focus on either a) explicit causal-effect processes, or b) use qualitative tacit to tacit methods, such as team building exercises. The focus of this investigation is to find and test methods, in an actual business case, that organizations can incorporate as a formal and regular part of their continuous quality improvement programs, to explicitly model, and adapt over time, their tacit value creating knowledge processes.

Nonaka & Takeuchi (1995) warn that it may take a combination of methods to externalize tacit knowledge into explicit knowledge. This investigation used traditional methods from quality and a range of tools developed by systems dynamists. Six Sigma Quality tools were used to benchmark functional operations. Cognitive mapping of mental models, based principally the methods of Eden & Ackermann (1998), was the primary methodology utilized to elicit tacit/implicit knowledge, develop emergent strategizing and enable reflective organizational learning. Additionally, neural net linguistic analysis tools based on the work of Woelfel et al (1989, 1993) were utilized to quantify language usage during the elicitation process. General principals of management cybernetics were used to diagnose the structure of the VC knowledge processes.

These methods were used to assist the organization in developing and testing a recurring process for emergent strategizing to improve the quality of decision processes. It was not within the scope of this project to attempt an analysis of the explicated knowledge to make recommendations on areas for improvement in its assessment processes at the functional execution level. Clearly, once the knowledge is explicit, such analysis can be done, but the focus here was to test methods of Externalization (Nonaka & Takeuchi, 1995) and emergent strategization, as a necessary first step that must be taken to enable such quality improvement.

The client conceived the consulting engagement as a Six Sigma quality improvement project using the DMAIC (Design, Measure, Analyze, Improve, and Control) and SIPOC (a value chain process mapping technique: Supplier, Inputs, Process, Outputs, Customer) methods, but admitted they were unsure how applicable they would be to improving qualitative assessment and decision processes. The DMAIC and SIPOC tools are based on the work of Harry (1994) and emphasize optimizing functional operations by focusing on customer needs and expectations

The DMAIC/SIPOC quality tools immediately presents the intellectual challenge as to just who are the customers of a venture capital firm. One normally identifies a customer as one who pays for value received. If this were to be held true for a VC firm, then the customer would be the end purchaser of the shares when and if venture capitalist decided to sell its investment. Instead, VC firms consider their customers to be those firms, which it considers for private equity investments. The 'successful' customer receives money from the VC firm. Venture capitalists treat capital as a commodity, which they disperse, as a service, to selected customers, in exchange for minority ownership positions.

Measuring the 'voice of the customer' presents the dilemma that all of its customers 'expect' and want the VC firm to provide them with equity, while VC firms in general only choose to invest in less than 3% of the prospects that approach them for funding. Any entrepreneur will be totally convinced of the investment opportunity they are providing to the VC firms and would want investment decision processes structured to assess the value potential from their point of view and not the VC's. Quality measured in this fashion would quickly result in investment processes stripped of rationality and the aims & objectives of the VC's investment strategy.

It is reasonable that the VC's customers should have an expectation that the venture capital firm will make an adequate, fair and timely investment decision as it relates to investment strategy. However, the venture capital firm does not reveal its investment strategy or its appraisals, so the customers are unable to discern if the venture capital firm's assessment of their firm was adequate or fair. The customer is only able to judge the venture capital firm on the length of time it takes to make an investment decision.

Traditional quality methods would prescribe that the key quality metric to the venture capital firm's process would be to measure pipeline cycle time (The length of time an investment opportunity is under consideration before a decision is rendered). However, a number of the VC's investment managers, senior and junior, advised that reducing pipeline cycle time would not necessarily equate to quality improvements in investment decisions and expressed concern that the project should not be focused on that cycle time as a primary metric. The investment professional team members also reported, prior to commencing the project, that they could not

fathom describing the complexity of how they make investment assessments & decisions, and expressed puzzlement how one would measure quality as it relates to it. Reactions such as these are not surprising if when one attempts to apply quality methods, designed for functional issues, to problems of strategic decisions and organizational learning of qualitative key competencies. This is not to say that application of such tools are necessarily inappropriate, but rather are not sufficient in and of themselves to fully diagnose the dynamics of the system.

The key to understanding the VC investment decision & assessment process is to recognize that it is a manifestation of strategy. The VC firm in this study had teams of investment professionals (IP's) which identify and assess deal opportunities. Qualified opportunities are presented to an investment committee (IC), composed of senior management for a funding decision. The investment deal teams acted as operation centers, charged with executing a strategy as given in a set of "Investment Guidelines", a list of ten criteria against which deal opportunities were to be judged (Confidentiality restrictions preclude disclosure of Investment Guidelines used by the VC firm). The ability of the investment teams, to execute effectively and efficiently, was driven by how well the IC implemented the guidelines in their investment decisions and how well the IP's understood the strategy, to be able to assess on their own, how well a given opportunity fitted the stated strategy. The IC acted as a group and so there must be a shared consensus as to what the guidelines (strategy) are among its members. The IP's operated individually, but must also have a shared consensus with the IC as their effectiveness and efficiency depended how well they understand the guidelines and expectations of the IC. Despite the expression by some, that cycle-time should not be used as a metric in assessing quality of the strategic decision process, Deutsch (1966, page 64) observed that game theory suggests otherwise:

> "*time* [should be introduced] *as an explicit variable in the planning of strategy and* [one must allow] *for a specific time and cost in the making of strategic decisions*"

Indeed, if the venture capital firm takes too long to conduct its assessments, it can be at risk of missing the 'window of opportunity' to invest, as the customer's are also soliciting offers from competing private equity firms. Pipeline cycle time in this investigation was taken as the output variable that measures the quality of the process used to implement the intended strategy. That is not to suggest that the shorter the cycle time, the better the quality. Instead the venture capital firm must become aware of the normal range or standard variance of its cycle times, by types of customers and types of deals, to make these assessments and decisions. It needs negative feedback that warns if: a) an IP, b) an investment team, c) specific deals or d) types of deals; start to operate outside of the range, in either direction. In a similar mode (and with the same caveat that it must not become focused on minimization), the venture capital firm must become aware of the normal range of costs of executing these assessments and decisions. These metrics should become fully communicated through out the organization, and not limited just to management, if the VC firm is to develop a quality mindset and steer its performance.

The DMAIC methods were used to establish performance benchmarks; however these methods do not provide the tools necessary to enable transfer of the tacit knowledge to explicit knowledge. The venture capital firm had been relying on an informal process mentoring of new employees as a means to train them, but their objective was to make the unspoken cognitive knowledge processes explicit, to reduce training time and limit loss of knowledge capital.

Until only a few years ago, many if not most scientists believed that cognitive processes where inherently unobservable. Now, however, cognitive science is one of the fastest growing areas in many academic disciplines. Some have focused primarily on creating genetic algorithms that mimic neural physiological structures to create and explore artificial brains as models to assist our understanding of human cognitive processes. Others, notably Woelfel, et al have focused on building metric-multidimensional scaling measurement systems (known as the "Galileo" method (Woelfel & Fink, 1980)) that could directly and quantitatively model social cognitive processes.

The Galileo model, in use for over 30 years, has been found to be extremely reliable and robust in hundreds of studies as a tool for quantitatively measuring and mapping cognitive processes, values and beliefs to degrees of precision that one would normally associate with physicists. However, the Galileo method becomes unwieldy for models in excess of twenty-five concepts as the number ratio pair comparisons to an arbitrary metric (R. Descartes, 16th century), required of subjects, begins to exceed 300, which begins to try even the most dedicated survey participant. The complexity of the phenomena being studied in this investigation was such that it was thought that perhaps 300 to 500 concepts were being used when making investment decisions. This is well beyond the scope of the Galileo method, as it would require pair comparisons in excess of 125,000. However the validity of mapping cognitive processes as a means to model shared social representations (Hayes, 1997) within organizations has been demonstrated. What is needed is a method of cognitive mapping, that perhaps not as robust and quantitative as the Galileo method, is capable of dealing with the complexity of the phenomena.

Tacit knowledge elicitation and qualitative cognitive model building methods have been developed, most significantly, by Ford & Sterman (1997), Keating, Robinson & Clemson (1994), Eden et al (1988, 1992, 1998). Ford & Sterman's approach is a very formal modeling methodology that provides greater precision than purely conceptual modeling, but the time and cost to undertake this method was beyond the scope of this project. In contrast, Keating, et al's Reflective Inquiry method does not attempt any modeling of cognitive processes, but does provide an ethnographic method for explicating tacit knowledge to the end of organizational learning and consensus building.

While the concept of reflective inquiry is sound relative to learning processes (Kolb, 1984), the method is high subjective with very little in the way of any scientific rigor. Having the researchers actively participate in guiding the direction of the discussions to develop theories is highly subject to bias. Keating provides no explanation as to the method for gathering and interpreting the information from the open-ended interviews. Only the participants in the process get the benefit of hearing the tacit knowledge converted briefly to explicit knowledge during the final discussion stage. There is no real method to capture the explicit knowledge so that it can be stored and shared. What is needed is a method that can achieve the benefits they cite, while being able to model the knowledge explicitly.

Eden, et al (1988, 1992, 1998) have been among the primary developers of the technique of metaphorical cognitive mapping based on the theory of personal constructs (Kelly, 1955; Hinkle, 1965; Weick, 1969). Eden developed a technique for mapping out personal and implicit constructs, elicited from individuals in interviews, in which the subject assists the interviewer by instructing how to connect concepts into causal-effect flow (Axelrod, 1976; Huff, 1990)

diagrams. The interview process is dependent on the skill of the interviewer[2] to diagram the concepts in real time with the subject, based on the application of hierarchical diagram coding principals developed by Simon (1962) and Harary et al (1965). Software tools (Decision Explorer™, produced by Banxia Software) have been developed to diagram and analyze the cognitive maps, based on the mathematics of set and cluster analysis (Aldenderfer & Balshfield, 1984).

Over the past decade, and with the assistance of Ackermann, Eden's methods have evolved into an emergent process approach to strategy, or JOURNEY, that is based upon Jointly Understanding, Reflecting, and Negotiating strategY. These techniques were initially called Strategic Options Development & Analysis (SODA) and were complimented by the use of cognitive mapping software called COPE, since renamed Decision Explorer. The JOURNEY process, for strategy making, at its heart, recognizes the basic cybernetic principals of feedback loops, as necessary for an organization to direct itself to its goals, and adapt its goals as a result of conscious organizational learning. Key to the JOURNEY process is being able to anticipate strategic futures and develop agreement in strategy review and organizational learning. Eden & Ackermann see anticipation of strategic futures as the process by which organizations deal with issue management in the context of embedded routines and embedded values, many of which are presumed to be implicit if not tacit. Cognitive mapping allows organizations to be able to capture not only its actual procedures and processes IN USE, but also its knowledge, wisdom and beliefs that drive the patterns of 'what we do now', 'the way we do it' and what 'we take for granted'. The JOURNEY method facilitates organizational learning through reflecting, revealing, exploring and achieving agreement on tacit embedded values, beliefs, alternative futures (Ringland, 1998) strategic options and knowledge processes to develop business models, goals and strategic intent.

The importance of cognition in strategy development has been receiving increasing appreciation (e.g. Huff, 1990, Schwenk, 1984, Walsh 1995). Bougon (1990) has articulated a unified theory of social system change and strategy, based on congregate cognitive maps that claims the dynamic cognitive approach makes organizational theory and strategy theory inseparable. Hodgkinson et al. (1999) have shown that the use of cognitive causal mapping can be used effectively in strategic decisions, to engage in a process of reflection, to reduce or eliminate framing bias (Kahneman & Tversky, 1984; Tversky & Kahneman, 1981; Thaler 1987).

Cognitive causal mapping is a purely qualitative modeling approach and, as such, is subject to introduced bias (Eden, 1983) from the investigator, who must interpret and code the elicited knowledge into the model. However, in an attempt to bring a more objective rigor to the method, CATPAC™, a neural network linguistic analysis software program was used in the coding and interpretation of the elicited tacit knowledge. The CATPAC software, based on the research of Woelfel (1989, 1993), has been designed to read and understand text and provides both a complete neural network of the interrelationships among the chief words in the text, along with a diameter-method cluster analysis of the main meanings.

CATPAC was used to provide an objective means to analyze text gathered in this investigation, to identify what concepts were used as synonyms and how concepts clustered together to delineate a line of thought. It was used as a tool to assist the merging of concepts obtained during the in-depth interviews for the cognitive maps, to validate that different interview subjects, using

different words, were in fact talking about the same concept and to aid the clustering of the congregate maps. CATPAC is a tool that can assist in removing subjective bias from the interpretation of the vernacular expressions of used by the subjects of study when constructing cognitive mental models of the patterns of the collections of secondary messages. Despite the use of such techniques to reduce bias, researchers must be cognizant that the verbal material itself, as provided by the subjects is likely to have bias. Sterman warns that

> *"The heuristics that we use to judge causal relationships lead systematically to cognitive maps that ignore feedbacks, multiple interconnections, nonlinearities, time delays, and other elements of dynamic complexity*." (Sterman (2000), page 28)

Given that there have been no previous attempts, at the venture capital firm, to explicitly model the tacit/implicit knowledge of its VC investment professionals, and recognizing that qualitative comparisons precede quantitative, it is entirely appropriate to start with explicit qualitative cognitive mapping as a precursor to development of quantitative metrics that could be undertaken as a second stage study. Furthermore, since knowledge has to be made tacit, before it can be used, and given that quantitative measurement is best used in common situations where can be taken for granted, it may be more useful to document explicit processes qualitatively, as a means to achieve strategic quality improvements and capture knowledge capital, rather than quantitatively. A VC firm's investment assessment and decision processes are not common or routine and are expected to remain tacit in actual use. For these reasons, Eden & Ackermann's JOURNEY method of conceptual modeling was used in this investigation.

Quality Improvement of Investment Decision Processes at the venture capital firm:
A test of methods for Quality Improvement in a Knowledge Based Organization

This project investigated the VC investment team's strategy and implicit/tacit knowledge processes using Eden & Ackermann's JOURNEY method. Cognitive mental maps were constructed to a) capture their tacit assessment decision processes for reflective organizational learning and b) to take the team through a process of emergent strategic planning in order to align the team and the investment commitee to the same strategic goals and objectives. Six Sigma and neural net linguistic analysis tools were used, respectively to establish performance metrics and to limit, as much as possible, introduction of subjective bias. Cybernetic principals were utilized to diagnose the system and its decision processes to identify areas for improvement by structuring feedback for requisite variety balance.

The investigation began with the series of non-participatory observations by attending several IP deal team meetings, at which opportunities were presented, discussed, reviewed, questioned, and rejected/approved. These are the key meetings where the team members decide which opportunities to investigate, solicit feedback from the investment committee members, give formal presentations of assessments on proposed deals to the IC and address issues/questions raised by the IC. The IC and the IP's typically discuss opportunities at length over a series of several meetings before a decision is rendered. Detailed notes were taken, during the investigation, on the subjects of discussion, the types of questions asked and the information provided for each of these types of meetings.

Open ended interviews were also conducted with each investment committee and IP deal team member to ask general questions as to how they thought the assessment and decision process

worked and what areas could they identify as problems in these processes and did they have any suggestions for improvement. Documents were also collected for review (e.g. copies of the IP's presentations, investment guidelines, marketing documents and various summary documents on the deal team that had been given at management review meetings over the past several months).

The purpose of the initial information gathering was to identify the 'big issues' that were confronting the group. The IP's indicated that they did not see any issues relative to their ability to conduct assessments, but did indicate that meeting the expectations of the IC was an issue. *"The goal post seems to keep moving."* The focus of the IC's questions on deals appears to change from month to month. They also indicated frustration with an inability to proactively pursue opportunities in specific sectors. *"We are always operating in a reactive mode."*

Another major issue that surfaced was that the deal team did not have any database tracking all of the deals that had been considered. They were only tracking those customers who had actually closed and gone to funding. Consequently they only knew how many had closed. They had only vague ideas as to how many opportunities had considered over the life of the deal team, how many had been rejected, how many had been approved but had not closed, but had no hard statistics. They had no idea what the monthly or weekly run rates were. They did not now how long typical deals remained in the pipeline, before approval/rejections, or the reasons why. In essence they had no hard metrics as to their productivity. There was not requisite variety in the system for organizational steering or learning.

Given that several individuals had expressed serious doubts as how one would even accomplish the task of this consulting engagement, it was decided not to even discuss any of the theories or methods with the team members, but rather introduce them slowly and seek to achieve an initial success (Katzenbach & Smith, 1993) which would give the team confidence in the project and the methods. In particular, any mention of 'cognitive mapping' was avoided and such diagrams were called SIPOC process maps, an internal term, in order to avert philosophical discussions or fears.

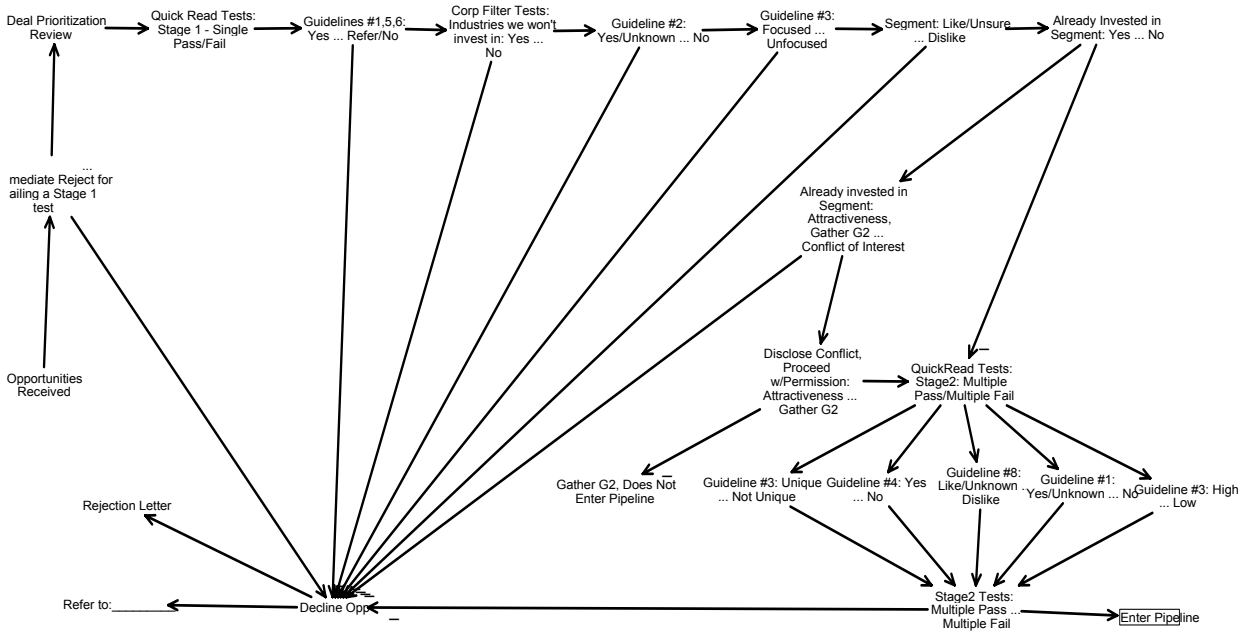
The first decision process that was chosen for mapping was the DPM (Deal Prioritization Meeting) meeting. The DPM meeting is an IP deal team meeting at which the group skims through the first few pages of a business plan of a firm looking for funding. The purpose of the meeting is for the team to very quickly assess whether there is enough interest in the opportunity to investigate it further, or to immediately reject it out of hand. The typical length of time was less than 5 minutes per opportunity. The DPM meetings usually lasted about 1 hour at which 10-15 opportunities were considered.

Mapping of this particular decision process was selected as the first step as it was a fairly simple assessment and decision process rolled into one. After observing two DPM meetings it was possible to draw a simple map of the decision process that appeared to be in use. This first map was then presented and discussed with each team member, individually, in which they were invited to add to, remove from or change any item on the map, so that it was 'correct', in their view, of the actual process used. The results from each interview were then merged to create an aggregate of the input from the team. The aggregate map was then presented and reviewed in a meeting at which the team was asked to come to an agreement as to what the map of the process

should be, to create an organizational congregate map (See Figure 1). The final aggregate maps of the decision process cannot be disclosed due to confidentiality restrictions.

Mapping of the DPM process was a successful first trial of the method. It permitted the team to see a simple demonstration of its use, allowed them to gain confidence in it and to see the value of the method. This greatly facilitated participation going forward with the project, particularly as the maps become more complex. It also allowed the team members to achieve consensus on an aspect of the process, to see that they were all operating from the same viewpoint. There did not appear to be any significant disagreements as to what the process was prior to the brief exercise, but it did uncover one major issue relative to ethics on improper collecting of data for competitive reasons. The managing director of the deal team agreed that this aspect of the process should be left on the map so that he could be reminded to educate IP's on the importance of following the venture capital firm's ethical guidelines. This clearly shows the potential for cognitive mapping to capture a sensitive and tacit issue that might have remained hidden otherwise. This demonstrates the importance of making tacit/implicit processes explicit so an organization can be accountable and protect itself from liability. It cannot be merely a yearning that *'I wish we knew what we know.'*[3], it is a requirement that the organization must know.

Figure 1: DPM Meeting Process Map

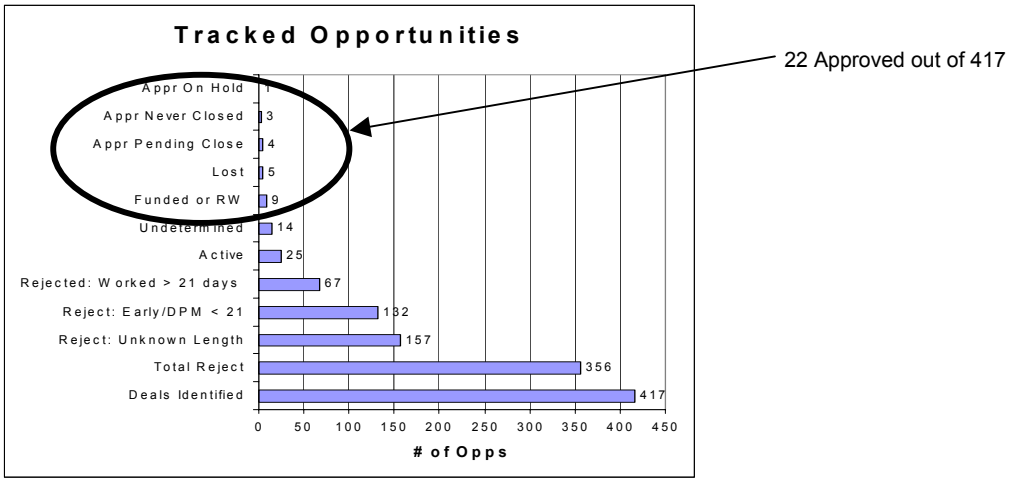


Mapping the rest of the investment assessment and decision processes was done following essentially the same method used for mapping the DPM process, but significantly more time had to be invested in preliminary data gathering and analysis to be able to conduct directed interviews on the qualitative processes. It is important to quantify, through traditional functional analysis of the inputs and outputs, that there are process issues that need to be addressed. On one hand it may indicate some trends as to where the issues may lie in the process, but it also provides critical feedback to the organization of the importance of the need to address quality improvement of its knowledge processes.

The lack of a historical database tracking the progress of past deals was a fundamental problem and well as an opportunity. On one hand there was no ready information tracking opportunities in time that could be analyzed to create benchmark statistics of performance. The team was on a bus without any speedometer, odometer, oil gauge or tachometer. They did have a compass and a map in the form of the investment guidelines, but there was no formal record documenting that these guidelines had been followed as a basis for rejecting or approving any given deal. Performance was only a qualitative reckoning and personal recollection. The deal team's managing director only had gut feelings that there were performance issues, but there were no concrete negative feedback mechanisms in place to confirm his beliefs. The opportunity was that since no database existed, in essence, variety had no restriction making it possible to view the entire spectrum to identify what might be relevant variety to capture.

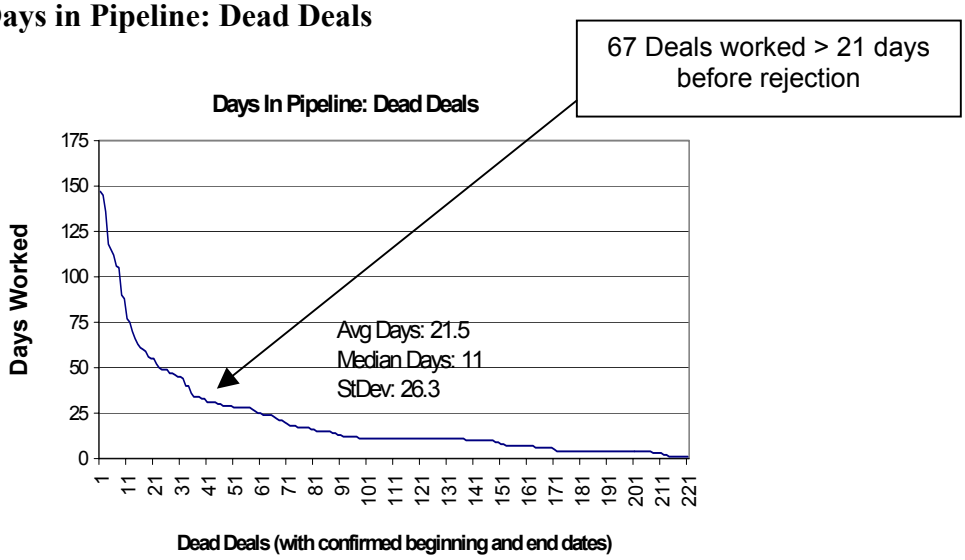
If a database existed, the data collected would have been a function of pre-set fields, potentially set below the threshold of requisite variety. This would have made it very difficult to identify the key information that was missing. This required reading through all of the paper files and presentations on every past opportunity, reviewing every summary document from all past meetings and reading through a trail of over 600 email messages exchanged internally and externally on the deals. Digging through this volume of data, patterns emerged as to the relevant functional phases of the assessment process. These were confirmed with the deal team members. A database with over 35 data fields was constructed. A database was successfully constructed tracking over 400 out of an estimated 700 deals that had been considered over a 12-month period, of which 22 deals had been approved for funding. (See Figure 2)

Figure 2: Tracked Opportunities



However it was observed that nearly 70 rejected deals, had stayed in the pipeline, under active consideration for more than 3 weeks, indicating that significant resources were being expended on a large group of deals that were never approved for funding by the IC. (See Figure 3)

Figure 3: Days in Pipeline: Dead Deals



Inspection of the dead deals actively worked more than 3 weeks before rejection revealed 80% of the time was devoted to working on opportunities that failed a key guideline which, by contrast, characterized more than 75% of the approved and funded deals. This clearly showed that somewhere in the process there was either confusion over the applicability of a guideline, or the assessment methods used by the IP's in respect to obtaining approval for an opportunity. This confirmed the need for the team to review its strategy and understand it implicit assessment methods.

To determine if both the deal team and the investment committee were "(all) following the (same) guidelines" in this process, a review of the guidelines was undertaken. The wording of the investment guidelines was identified as a potential source of confusion. In addition, the venture capital firm throughout its offices has a different, but somewhat similar set of guidelines that are used for a different class of investments. Furthermore, the e-mail trail of messages, between the venture capital firm executives, discussing the original construction of the guidelines was uncovered and reviewed and was found to mention other potential guidelines that did not make it into the final document. It was thought that possibly some of these guidelines might be 'leaking' into the decision process.

Over a period of several weeks, attending every meeting of the deal team, as a team or with the IC, detailed notes were taken, as before, to record[4] what were the central themes or issues that were being discussed relative to qualifying whether a particular deal should be approved for funding. The investigation specifically looked for recurring use of tests being used to judge opportunities, drawing from the three potential sources of guidelines and also looking for any other types of tests that appeared to be emerging. From these sessions, it was observed, subjectively, that there were seventeen 'apparent guidelines', in use for investment decisions. Additionally, nearly 50 key attributes were identified as appearing to define these apparent guidelines. No attempt was made to record the numerical occurrence of the patterns of apparent guidelines in use. This could have been done to bring greater quantitative rigor to the process and should be considered for future application of these methods. However, the investigator needs to

look for emergence and so should be wary of eliminating rarely mentioned strategic options as that might exclude something that is needed for requisite variety.

Preliminary maps of a) the overall functional process used (Figure 4), b) the interconnections between the guidelines (Figure 5)[5] and c) each individual guideline[6] (with its apparent connections to the key attributes) were then drafted by the investigator. Although this aspect of the method used is based on Keating et al's Reflective Inquiry method and can be a source of introduced bias, the VC firm was expecting the investigator's observation skills to be capable of reasonable objectivity to sketch the 'big picture' of the process overview for them, to minimize time impact on carrying out their normal operations. The JOURNEY method, combined with aspects of Reflective Inquiry as heuristic methods (see Table 1) was then employed for the gathering/measuring of the data, analysis and implementation.

The maps of the apparent guidelines and key attributes were used in conducting in-depth directed interviews (Table 2) with each member of the deal team and the investment committee. The data/drawings collected from each interview were then entered into the cognitive mapping software (Decision Explorer) to build out an aggregate map of the entire knowledge decision process used. The interviews were recorded so that they could be transcribed and analyzed linguistically. However it soon became readily apparent that it would not be possible to use the linguistic tools, as envisioned, to aid in the objective analysis of the raw verbiage spoken in the interviews. Neural net analysis depends on recognizing the patterns in how words are repeatedly used. Using and drawing metaphorical maps in the interviews resulted in conversations where much of the information being discussed had a visual reference. Although the word may have been used once in the discussion, further reference to the concept involved pointing to it, limiting the utility of the linguistic tool.

Table 1: Method used for eliciting emergent strategy and implicit knowledge.

1) **One-on-one interviews** - Conduct in-depth one-on-one interviews to capture from each participant, their individual perceptions as to what the strategy is and what are the issues that result from that strategy. (i.e. define the strategy; what does it take to actually implement the strategy.) This was done using the draft maps showing the relationships between:
    a) The functional process
    b) The apparent guidelines,
    c) Each guideline and its key attributes, as developed by the investigator.

    Start by first asking the subject for permission to tape record the interview, then proceed by asking him or her to add, subtract or change any item they desire on the overall pipeline process map. Second, repeat with the guideline map. Third, repeat with each individual guideline & key attribute map. Once the subject is satisfied that the maps reflect their mental model of the guidelines and key attributes, proceed to go through each attribute and ask the subject open ended questions about each attribute. At the direction of the subject add addition items to the maps that define how issues drive the strategy and the knowledge process and how they interrelate. (See Table 2 for a complete detail on the interview process)
2) **Aggregate cognitive maps** - Build out aggregate cognitive maps of the strategy and the attribute issues that drive it and how they interrelate as captured from the all interviews. Use neural net linguistic analysis to aid in the objective interpretation of the data.
3) **Strategy & Knowledge Process Workout Session** - Hold a team meeting at which the aggregate maps of the strategy and issues is presented for debate between the team members so that they can gain insights from each other, see where disagreements and confusion lie and work towards a consensus as to what should be the strategy and knowledge processes moving forward.

Table 2: **Mapping interview process used**[7]

1. **Pipeline Process Map** ('10,000 meter view of the process', see Figure 4) Review the map, ask subject to add, subtract or change and item on the map. Set the stage, the objective of the interview: "We want to understand the "white space" between the functional operations":
   - Why, what, how do they apply the guidelines?
   - Why, what, how do they gather information?
   - Why, what, how do they interpret the information?
   - Why, what, how do they assess, weight the importance?
   - Why, what, how do they elicit feedback (internal & external)?
   - Why, what, how do they approve vs. kill a deal?
   - Are any steps or links missing in the process?
2. **Investment Guideline Maps** - Review the Investment Guidelines vs. the Apparent Guidelines ('5000 meter view of the process', see Figure 5).
   - Discuss 'division & interdependencies between assessments that are quantitative vs. qualitative.
   - Is anything missing or that does not belong, are the links in the right directions, are there any new links to add or that should be removed?
   - What is easy? What is hard?
3. **Guideline & Attribute Maps** - ('1000 meter view of process',) Start by selecting a relatively simple guideline, to gain the confidence of the subject that it is possible map their ideas of how the process works. Progressively work into more complex guidelines, while leaving some simple ones to the end, to deal with interview fatigue, so they can see there is 'light at the end of the tunnel'.
   - Discuss interdependencies between attributes.
   - Is anything missing or that does not belong, are the links in the right directions, are there any new links to add or that should be removed?
   - Drill into each attribute and ask subject to drop down to the '500 meter view' with open-ended questions. As new issues or concepts emerge, successively drill into those with the same open-ended questions to drop down to the 250, 100 and 50-meter views. Draw links between the concepts as they emerge. Use the subject's words and phrases. Questions to ask:

- How do you do this?
- Tell me the top five things that immediately come to mind when you think of this?
- What defines this?
- Can you give me an example?
- What do you scan for?
- What drives this?
- What are the issues that relate?
- What is meant by _____?
- How do you decide this?
- Does this link to other guidelines or attributes on other maps?
- What is easy? What is hard?
- How long does this take?
- What is this dependent on (internal & external)?
- What are the inputs? Where do you get them?
- What are the outputs? Where do they go?
- How do you connect these?
- Please clarify that further?
- Please explain?

Preliminary Maps of Pipeline Process & Apparent Guidelines: These maps were the starting-point from which all maps were drawn during the directed interview process.

Figure 4: Pipeline Process - 10,000 meter view

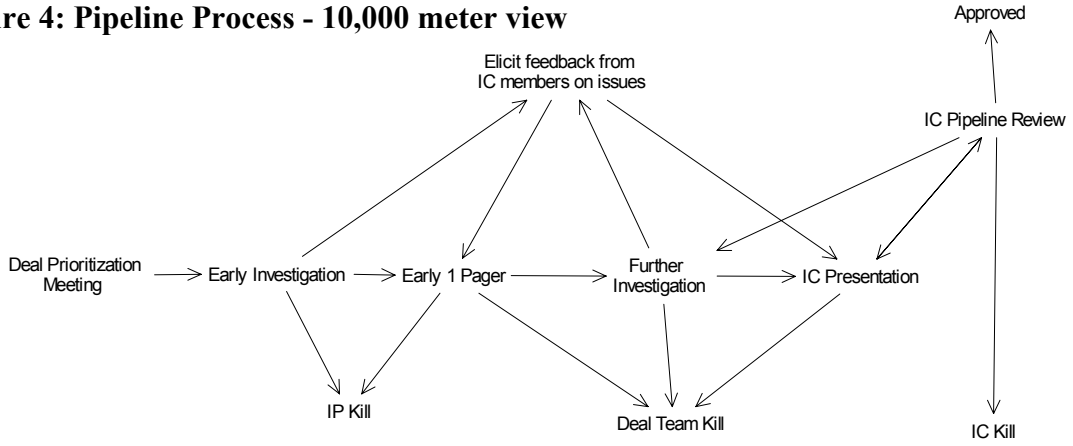
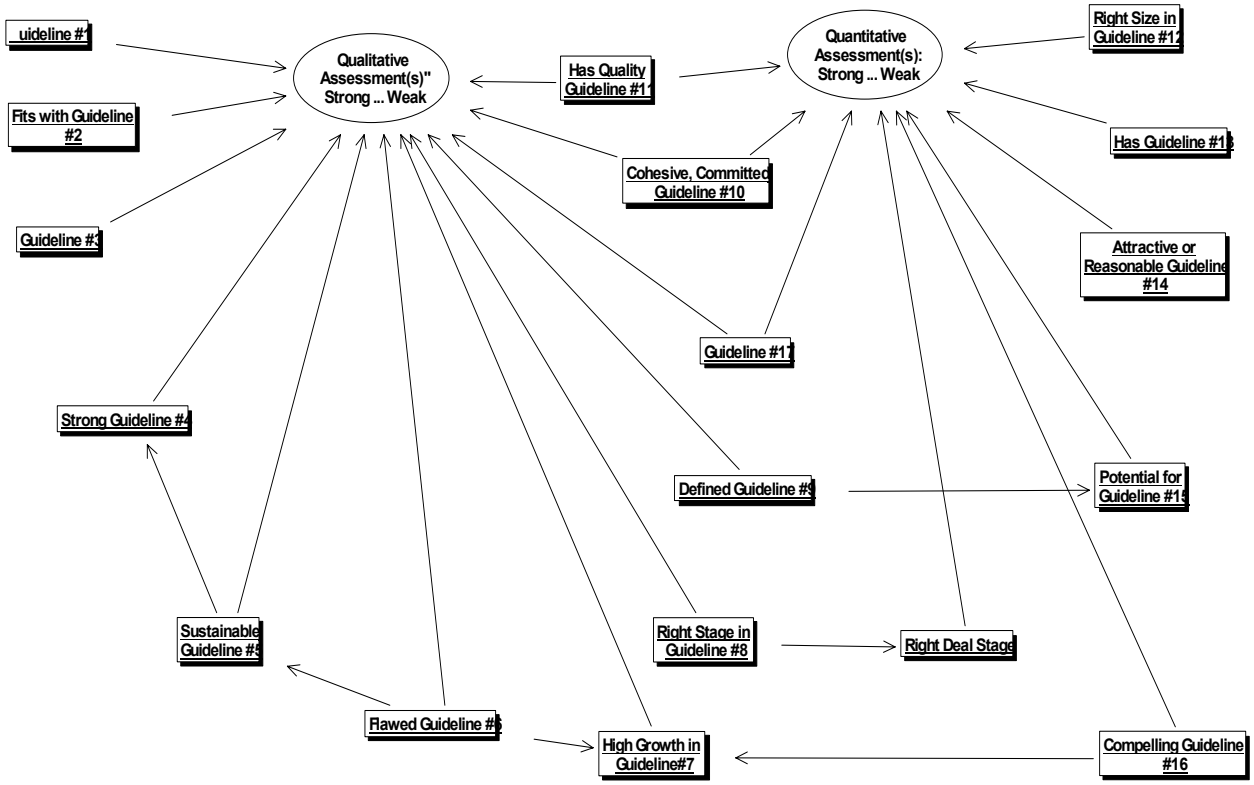


Figure 5: Apparent Investment Guidelines- 5000 meter view



The interviews provided individual maps that needed to be merged together to create an aggregation of their input, but clearly (and it is expected) much of the data gathered should overlap. The extent to which there is overlap in the maps between individuals, could be an extremely useful measure of the degree of coherence or consensus shared by a team. This would be an excellent area for further research as it could provide a true quantifiable metric of something that is only qualitatively assessed at present. The IP's and the IC team members should have a 'mental map' that reflects their individual perception of the congregate organizational map that represents a unified view of the organizational strategy and knowledge processes.

> "*while different-looking, special-purpose, expressions of the underlying collective cognitive structure of a social system are possible, there exists only one such underlying collective cognitive structure. This structure is a dynamic cognitive structure both continuously enacted and negotiated by participants. This collective structure is the congregate cognitive map responsible for the organization and the strategy of a social system*." (Bougon, 1992, page 369)

The linguistic analysis software (CATPAC) was found to be useful in assisting the merging of the individual maps. Concepts were entered as individual nodes, into the master maps straight from the raw data. The raw master map, after all of the data was entered, contained in excess of 700 separate concepts. CATAPC was able to quickly identify different nodes that contained essentially the same words, or words that were used in the same way. After using CATPAC, the investigator was able to merge[8] certain nodes together, resulting in a final master aggregate map

that contained 568 concepts (e.g. CATPAC identified that the word 'opportunity' and the word 'firm' were nearly always used together, hence on the maps those two words have been merged to the concept 'OppFirm"). Each concept was then classified according to the way that it appeared to be used in the process (e.g. inputs, outputs, guidelines, decisions, etc.) Table 3 gives the list of all of the identified different classes of concepts used in investment assessment and decision processes at the venture capital firm, along with the definition of the classification, and the number of occurrences of each type in the process.

Table 3: Types of concepts used in decision process

Concept Type	Definition	# of Nodes
Investment Guideline	The guiding principal strategies that our investments are to meet	17
Key Attributes	Criteria the OppFirm should meet *for the most part* as a basis to show that they adhere to the Guidelines	45
Assessment	Tests that we use to determine if the Key Attributes are being met	279
Root Input	Inputs to the process	17
Dependency	Things that are external to the VC firm that the deal team is dependent on in the process of assessing the OppFirm	62
Action Taken	Functional actions that need to be taken in the process	35
Factor Comment	'Rules of thumb" to the Process	89
Decision	A decision that the process is contingent on	9
Document	A document that needs to be produced	6
Outputs	Outputs from the process	9

Operationally, the investment process works by receiving inputs, to which guidelines are to be applied. The guidelines are applied using key attributes. The attributes are tested using assessments and 'rules of thumb'. However during the process, there are external dependencies over which they have no control, also the IP's must undertake certain functional actions, including obtaining other inputs & creating certain documents. At the end of the process, a decision is made and certain outputs and documents are generated.

However, from a systems dynamics perspective, the IP's role is to act a variety filter. The IP's handle the full variety of the external market and reduce it down to 568 elements (the number of possible states the system can take — the measure of the complexity of the variety in the system). This variety gets further reduced by the IP's who package the information into meta-messages (*a collection of secondary feedback messages)*, which are then communicated to the IC. The meta-messages act as symbols that, by reference, encapsulate all of the previous variety. It is this secondary variety, which the IC uses to make the investment decisions. The variety the IC deals with is substantially less (17 apparent guidelines, 47 key attributes and 9 types of decisions), a total of 73, a nearly eight-fold reduction in variety. However it should be noted that many of the 'rules of thumb' were provided during the, mapping process by IC members, so they may in fact be really attempting to use 162 degrees of variety in their decisions, or only a 3.5 fold reduction. While these may seem like major reductions in variety, they really are not. No rational business executive would claim that an organization firm could be operated using a strategy with 17 critical elements, it is simply too unfocused.

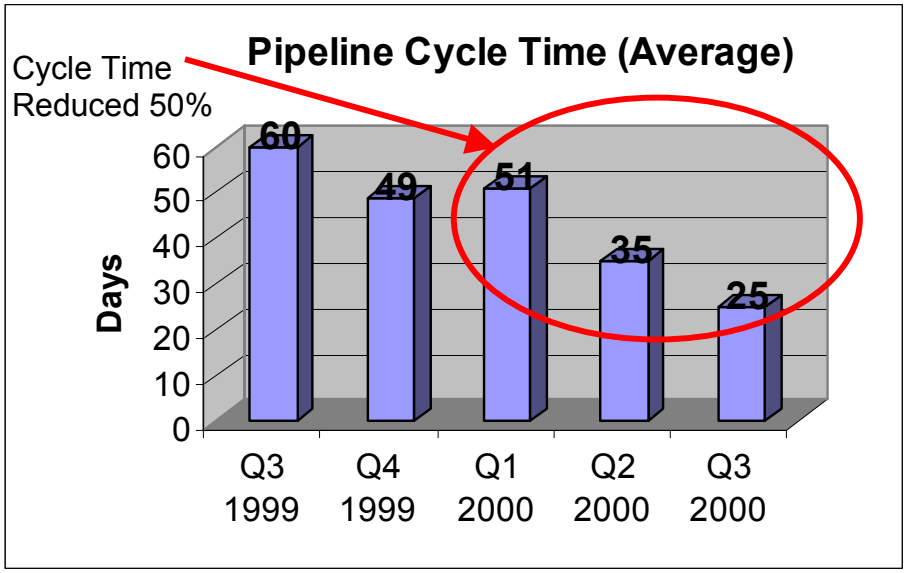
Cybernetic principals would suggest that fundamental source of the problems the VC firm was having (reducing its cycle time and improving the quality of its decisions) was due to having too much meta-message variety in the system at the decision stage. A high level of complexity makes it too difficult to digest and arrive at a decision. The IP's take anywhere from 20 to 100 hours investigating a particular active deal that gets brought before the IC. They have the time to deal with the level of variety that they encounter. The IC on the other hand only gives active consideration for three to five hours on any one deal[9]. They simply do not have the time to digest a huge amount of variety. When the IC attempts to use too much variety it makes the job more difficult for the IP's, as the must be prepared to put that level of variety into their presentations. If they put all of it in, they might get rebuked for not being focused, but if they leave it out, it then becomes a guessing game as to 'which variety' the IC will be looking for on any given deal.

To solve this issue, to reduce the variety in the decision stage of the process, the IC and the IP's must arrive at a shared consensus as to the amount and type of variety that is to be used in the decision process. This was accomplished by the final step in the process by arranging a three hour strategy workout session of the IP deal and IC teams, at which the aggregate maps of each of the apparent guidelines were presented so that the team could JOintly Understand & Reflect on the information, and use them as a basis for NEgotiating strategY (JOURNEY). The outcome of the meeting was agreement to move forward using eleven of the seventeen proposed guidelines. The IP's and the investment committee then agreed on 38 key attributes to define the eleven guidelines. The strategy workout session provided nearly a tenfold reduction in variety from the 568 concepts, and a 35% reduction in the guidelines and a 20% reduction in the key attributes. This process created a more manageable set of guidelines for both the IP's and the IC. The IC could now focus more concretely on the essential elements for making a decision and the IP's would no longer be guessing as to which variety they needed to present. It was predicted that this should decrease pipeline cycle time and allow the venture capital firm to better meet its customer's expectations, the definition of quality.

Pipeline metrics must continue to be monitored to observe if the predicted performance gains are achieved. Only by combining traditional algorithmic quality methods as feedback mechanisms, can the team monitor if quality in their decisions is being achieved. But, this is dependent on the deal team and the IC to actually follow the new guidelines. It would be useful to rate each new opportunity against each of the guidelines as a means to check which ones they are using and to avoid drifting away from them. Such ratings could also be used as a reference to judge the degree to which each opportunity meets the guidelines, however caution should be used. The decision is an emergent phenomenon and as such the whole is greater than the sum of the parts. A sum of the ratings should not be used deterministically in the decision process. However, if in a given instance, one or more guidelines are found to not apply, and another emergent guideline is used, the team should make a note to collect these emergences and observe if they develop into a pattern of use. To maintain quality and to enable organizational learning the investment guidelines should undergo regular (perhaps every 6-9 months) reviews, via heuristic methods, such as those used in this investigation, in the context of market changes, which are either anticipated or adapted to. It is through the combination of both methodological approaches, algorithmic and heuristic, that quality can be achieved and improved.

The consultant, as a follow-up to the engagement, tracked the VC firm's deal team pipeline cycle time during the two months following the strategy workout. Pipeline cycle time was found to have been cut in half compared to the cycle time in effect prior to the engagement, a convincing demonstration of the effectiveness of the methods used in this investigation. (See Figure 6)

Figure 6: Pipeline Cycle Time



Conclusion

The aim of the investigation reported in this paper was to explore methods of quality improvement that can be applied towards strategic tacit knowledge-based processes and capabilities. Algorithmically based quality improvement programs focused on optimization of functional operations have often failed to provide differentiation in the marketplace because such tangible processes only create a minor part of an organization's value-add. The effects are incremental and easily appropriated by other firms. The key resources and capabilities that drive the majority of value creation in the modern knowledge-based economy are human knowledge embedded. It is not well understood how to retain, maintain, transfer, improve upon and develop: existing and new distinctive capabilities, when they are implicit, qualitative and individually known.

Heuristic methods from management cybernetics were investigated and tested as quality improvement tools, in an actual business case, for intentional, concerted design of emergent strategy and organizational learning. Cybernetic principals were used to investigate the structure of resources and capabilities to reveal how decisions resulting from managerial policies contribute to organizational effectiveness (i.e. quality improvement of resources), or alternatively to loss of knowledge capital. By explicating the tacit capabilities and the dynamic processes in which they are used, it became possible to explore the probable impact of instituting different strategic options or scenarios that will lead to greater effective use of the organization's resources. These methods can aid the organization's abilities for adaptation and anticipation of market contingencies by providing systematic tools that can enable the building and maintaining

of a 'portfolio of competencies' to expand the 'opportunity horizon' (Hamel & Prahalad, 1996) of the organization.

It was found that a combination of both traditional quantitative methods and heuristic qualitative methods were necessary for the investigation. Performance metrics of operational input/output flows are crucial to measuring the 'state' of the system and are required to provide measured feedback information on performance of the qualitative knowledge processes. While such methods can serve as performance indicators (positive and negative) they are not sufficient to diagnose and engineer improvements to the tacit knowledge processes. Cognitive mapping was successfully employed to externalize the tacit knowledge into metaphorical models, so that it could be made explicit and shared. This enabled the investigator to measure the degree of complexity of the variety at different 'state' levels in the organization.

Analysis revealed that the decision process was encumbered by too much informational variety in the secondary messages that serve as the 'conscious' symbols of the primary assessment processes. This caused confusion as to which primary assessments should be communicated into secondary symbols for action upon at the decision stage. Delays or lag (Beer, 1985) were generated in the decision processes, as requests for different messages were fed back in cyclical loops until the decision-makers had absorbed all of the variety they were seeking. The system was out of balance in respect to expectations as to the amount and type of requisite variety needed to be transmitted between different levels in the system.

Ackermann & Eden's (1998) JOURNEY method was employed as a technique for emergent strategizing and reflective learning, between and within two different organizational levels, to enable both to obtain consensus on the amount and type of variety to be transmitted between them. Agreement was achieved to reduce the variety of the decision strategy parameters by 35% and the key assessment attributes by 20%. Pipeline cycle time was measured two months following the consulting engagement and was found to have been reduced by half, a doubling of performance.

Additionally, neural net linguistic software was utilized to objectify coding and interpretation of the textural data gathered during the mapping process. The visual nature of the mapping interview technique itself, limited the utility of the analysis, but it was successfully used to merge concepts from individual maps analysis to create aggregate maps. This can provide an effective method to limit the impact of subjective bias that can be introduced during aggregation of concepts as identified by Eden (1983).

It was not within the scope of this project to attempt analysis of the tacit assessment processes. However, once explicated into models, such analysis would be an appropriate next step. Beer's (1985) Viable System Model should be considered as an assessment diagnostic tool as the organization is making judgments as to the likelihood that the firms, in which they are investing, have the ability to become viable. Understanding the generic structures and patterns of viability may assist in the further reduction of the variety necessary for quality venture capital decision processes.

In conclusion, it was found that that quality can be improved in knowledge processes through emergence of tacit knowledge and strategy that enabled the organization to find balance the requisite variety needed for organizational steering. Until an organization is able to make explicit, their tacit capabilities and processes, they will not be able to learn from their knowledge and leverage it strategically. This can only be done in conjunction with performance metrics that can provide negative feedback, if the quality of the steering strategy is slipping (due to inadequate or too much informational variety). These are issues of strategic quality management of communication and control, in the organization, that determine its ability to learn, adapt, anticipate and achieve differentiation and accountability in meeting customers value expectations in the marketplace.

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[1] This similar to what Deutsch (1966), page 75, observed about military intelligence organizations, diplomatic agencies and large scale industrial research laboratories as being: *"assembly lines of information, assembly lines of thought"*

[2] The author of this paper attended a seminar taught by Ackermann (June 2000) in Eden & Ackermann's cognitive mapping interview and analysis methodology in preparation for this investigation.

[3] As reported by Hibbard, J. (1997) in Information Week, October 20, Section: Trends C. Jackson Grayson, chairman of the American Productivity & Quality Center, related a story about a company CEO who, in a moment of contemplation, revealed a deep desire to know what his organization knew.

[4] Tape recording and transcribing the verbiage from such meetings is recommended. Ideally the transcripts would be analyzed using neural net linguistic analysis to aid objective interpretation. However, tape recording of the meetings in this investigation was not done due to the highly sensitive and confidential nature of the discussions involving details to which the venture capital firm itself is subject to non-disclosure requirements.

[5] The map shown in the Figure 5 shows the linkages between the guidelines, but due to the highly competitive nature of the VC industry, the actual Investment Guidelines used by the firm, investigated in this business case, can not be disclosed.

[6] The maps used as the survey instrument in this investigation showing the linkages between each guideline and their key attributes cannot be disclosed due to the highly competitive nature of the VC industry.

[7] Interviews typically took 2 hours to complete

[8] See Eden (1983, 1989) on merging with 'great care' and caution

[9] The average time spent by IP's and IC members on any one deal are estimates of the investigator based on subjective qualitative observation. This clearly could and should be quantitatively measured in the future.