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# An Investigation of a Methodology to Assess District Performance

Peter Simpson

*Johnson & Wales University - Providence*


Robert K. Gable

*Johnson & Wales University - Providence, [rgable@jwu.edu](mailto:rgable@jwu.edu)*

Stacey L. Kite

*Johnson & Wales University, [skite@jwu.edu](mailto:skite@jwu.edu)*

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# An Investigation of a Methodology to Assess District Performance<sup>1</sup>



Peter Simpson  
Stacey L. Kite  
Robert K. Gable

May, 2009

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## ABSTRACT

This study investigates a resource-based methodology to assess district performance as an indicator of student achievement on standardized assessments. The problem that this investigation addresses is that performance measurement and the associated decision-making is indeterminate. There is a lack of empirical research that relates decision-making about resource utilization to performance.

The study utilizes structuralism to assess the relationship between the independent variable of resource utilization and the dependent variable performance. Complex Adaptive System theory is used as a framework for Concept Mapping methodology. The study is grounded in theories from Complex Adaptive Systems and Microeconomics that state that performance is a function of capacity. An adaptation of the generic value chain (Porter, 1985) is designed as a representation of the education delivery systems for  $N=7$  districts. Previous sequences in this research project have established performance levels and variations from the independent variable of socioeconomic status (Simpson, Kite, & Gable, 2007). The concept maps illustrate the nature, magnitude, strength and underlying relationships for thematic patterns of resource utilization for the  $N=7$  districts.

The concept maps provide an explanation for some of the variation in performance that does not relate to socioeconomic status. The explanation of variability in performance represented by the concept maps is intended for diagnostic applications, not to establish best-practices that can be transferred from high performing to low performing districts. The primary application of the methodology is for strategic or intervention planning.

## I. INTRODUCTION

In the Publication, *Making Money Matter*, the National Research Council (NRC) (1999) quotes McDermott (1976) who states that, “educational policymaking is now in a state of indeterminacy. No satisfactory criteria exist by which to make important decisions regarding school finance” (p.161). Lack of consistent empirical evidence from research about the relationship between resources and performance was, and still is, the reason for stating that indeterminacy exists. Indeterminacy continues to be a parameter of institutional decision-making, because of outcome uncertainty, uncontrollable variables, contextual variations and conflicting perceived and real goals (Cameron, 1986).

The most prominent example of indeterminacy in school finance is the failure of production function research to establish a relationship between the independent variable of spending and the dependent variable student performance. Hanushek (2000) stated, “377 separate production function studies have been published in 90 publications before 1995, but only 27% of studies indicate a positive and significant effect. In fact 7% even suggested that adding resources would harm student achievement “(p.4203).

Production function research is analytical indeterminacy, but not the cause. Researchers agree that there is an array of inherent reasons for inefficiencies in education, (Burrup, Brimley, & Garfield, 1996; Evers & Clopton, 2006; Odden & Busch, 1998; O’Day, 2002; Hanushek, 2003; Reschovsky & Imazeki, 2003) which contribute to indeterminacy in school finance, but provide little empirical support of the systematic causes. This investigation proposes that decision-making about

resources at a school district-level can be informed with systematic analyses of performance data, variations in cost structure and thematic patterns of resource utilization within an education delivery system. A working definition of resource utilization is that resources can increase or diminish the value resources as they move through a delivery system (Porter, 1985). Resources consist of money people and time. (Fullan, 2005). The relationship between performance and resource utilization in education is paradoxical. Cohen, Raudenbush, and Ball (2003) present the paradox by stating that, “Resources are not self-acting. The effects of resources depend on both access and use: students and teachers cannot use what they don’t have, but the resources they do have are not self-acting. Simply collecting a stock of conventional resources cannot create educational quality” (p.122).

### **Statement of Problem**

This study addresses the problem that there is a lack of understanding about the determinants of district performance as a measure of the organization's capacity to achieve student achievement that is not accounted for by socioeconomics (Brown & Saks, 1981). Specifically, there is no systematic process for decision-makers at the district-level to understand the relationship between resource utilization and performance outcomes. In the study *Equality of educational opportunity* (Coleman, Campbell, Hobson, McPartland, Mood, Weinfeld, & York, 1966), known as the *Coleman Report*, part of the first, and a lasting finding was “socioeconomic factors bear a strong relationship to academic achievement.... it appears that differences between schools account only a small



fraction of the differences in pupil achievement” (p.22). Essentially, the *Coleman Report* suggests that school-based resources do not relate significantly to student achievement. During the 40 years since the publication of the *Coleman Report*, there has been a lack of consistent empirical evidence to contradict the finding. The relationship between the independent variable of socioeconomic status and the dependent variable of student performance is confirmed by several researchers including, but not limited to Gaudet (2000) reporting that, “84% of the variation in the average [student achievement] score is explained by [a socioeconomic indicator]” (p.15). Gaudet’s study of 140 districts in Massachusetts with similar socioeconomic status found that, “there was a 39 scaled score point range of variation between the district’s actual and SES [socioeconomic status]-predicted score. This range extended 25 points above the expected score to 14 points below the statistically-predicted score” (p.16). This variation is an indicator that, even within the socioeconomic status indicator, some indeterminacy exists (Evers & Clopton, 2003; Gaudet; 2000; Simpson et al. 2007; Walberg, 2003).

This study proposes that a resource-based phenomenon of resource utilization occurs that relates to district performance as an indicator of student achievement. This phenomenon enhances or diminishes the value of resources based on the grounded-theories of capacity. Gaudet’s (2000) observation supports Porter’s (1985) definition of resource utilization, which is a proposition of this study, “[some] school districts [appear to] add value to the learning readiness of their students as indicated by higher-than-predicted test scores” (p.3).

## **Background of Problem**

In Massachusetts, standards-based reform began in 1993 and the School and District Accountability System began in 1999. During the 2001-2002 school year, high-stakes standardized testing, called the Massachusetts Comprehensive Assessment System (MCAS), established baseline data of school and district student achievement levels. MCAS was implemented as the instrument for meeting the goal of Federal No Child left Behind (NCLB), which is that all students will achieve proficiency in English Language Arts (ELA) and Mathematics. Massachusetts relies on accountability policies to improve the school and district's student achievement. Adequate Yearly Progress (AYP) is the accountability gauge to measure the progress between a baseline Composite Performance Index (CPI) and the NCLB goal.

## **Performance Measurement**

The performance index representing attainment of AYP is called the Composite Performance Index (CPI). It rates the school and district's gain toward achieving the Massachusetts reform goal for each district, school and subgroup of students. This rating system is depicted in Table 1. CPI measures the gain that a district achieves each year toward the Massachusetts Reform goal that all students will score 'Proficient' on MCAS. CPI measures the progress towards this goal independently of the previous year, but a statistical phenomenon does occur from year to year. In the earlier years from 2000, which was the baseline year, to 2004 the growth in the CPI of a district is characterized as steady gains, because

it has been easier to improve CPI with regular education and non-minority students.

**Table 1**  
**Composite Performance Index (CPI) Rating System for Adequate Yearly Progress for Schools and Districts in Massachusetts**

Performance Rating	Composite Performance Index Range
Very High	90 - 100
High	80 - 89.9
Moderate	70 - 79.9
Low	60 - 69.9
Very Low	40 - 59.9
Critically Low	0 - 39.9

*Note: From "School Leaders Guide to the 2006 Cycle IV Accountability and Adequate Yearly Progress (AYP) Reports," By Massachusetts Department of Education. p.3. (2006)*

The data used to determine the CPI of a school district or subgroup of students is based on AYP, which is represented by the following equation:

$$A + (B \text{ or } C) + D = \text{AYP} \quad (1)$$

*A* represents the participation rate of students in MCAS for regular education or alternative assessment for special education students. *B* is the average school, district or subgroup CPI. *C* may be used as an alternative when the assessment cycle for a school year, improvement target is met. *D* is either a combination of 8<sup>th</sup> grade attendance rate above, a 1% improvement over the previous cycle or Competency Determination, graduation as measured by passing MCAS, greater than 70% (Massachusetts Department of Education, 2006).

## Research Design

This is a causal-comparative study of  $N=7$  school districts that utilizes structuralism to “focus on the systemic properties of phenomena, including relationships among the elements of the system” (Gall, Gall, & Borg, 2007, p.523). The phenomenon is that researchers propose that performance is a function of capacity-building (Cohen, Raudenbusch, & Ball, 2002; Corcoran & Goetz, 1995; Elmore & Fuhrman, 2001; Fullan, 2005; Staber & Sydow, 2002), but there is no empirical evidence to support this phenomenon. To establish empirical evidence this study proposes that capacity-building is a function of resource utilization, which is influenced by a set of thematic critical variables and archetypical systems within education delivery systems.

The research question for this study is:

*What are the nature, strength and underlying relationship of thematic patterns of resource utilization within education delivery systems that relate to capacity-building?*

## Theoretical Framework

The theoretical framework for this research question is that as, organizations, school districts are complex adaptive systems (Gaziel, 1996; Monk, 1981; O’Day, 2002; Ostroff & Schmitt, 1993;). As complex adaptive systems, the theoretical frameworks apply to school districts. Complex Adaptive Systems are dissipative with recurring thematic patterns that can be categorized as evolutionary, emergent, and self-organizing (Anderson, 1999; Brownlee, 2007; Dooley, 1996; Foster, 2000; Levin, 2002; Morel & Ramanujan, 1999). These dissipative characteristics of organizations as Complex Adaptive Systems have critical

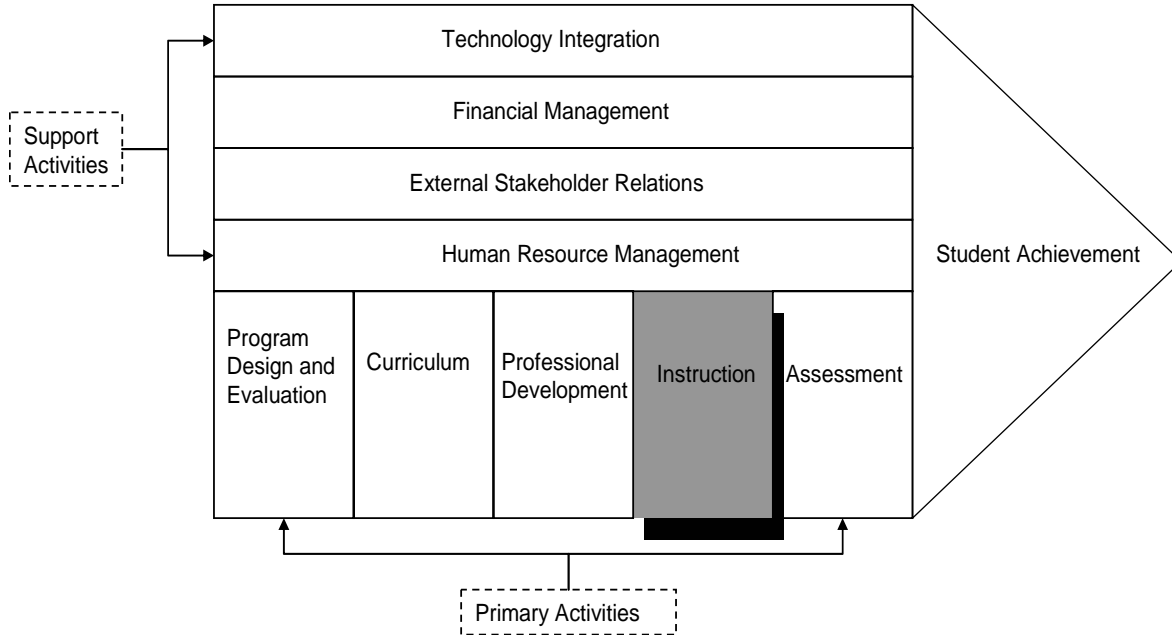
variables. These critical variables represent the nature of the recurring patterns. that can include, (a) cumulative learning (Eden & Ackermann, 2000; Jackson, 1998; Porter 1991, 1985; Swieringa & Wierdsma, 1992; Teplitz, 1991) (b) collective learning (Cameron, 1986; Gaziel, 1996; Ostroff & Schmitt, 1993), (c) innovation (Jackson, 1998; Porter), (d) linkages between activities within systems (Anderson, 1999; Levin, 2002; O'Day; Porter), and (e) social capital (Bergstrom, Roberts., Rubinfeld & Shapiro, 1988; Gold,Simon, Mundell, & Brown, 2004; Honig, 2006; Shipps, 2003; Stone, 1997).

These critical variables can be diminished by archetypical systems (Flood, 1989; Lyons,2004; O'Day, 200; Macintosh & MacLean, 1999; Senge, 1990) that can include, (a) faulty incentives (Lyons; O'Day), (b) competency traps (Eden & Ackermann, 2000; Macintosh & MacLean; O'Day), (c) misaligned goals (Flood; Senge), (d) poor resource distribution (Flood; Hardin, 1968; Lyons; O'Day; Senge), and (e) corrective actions that fail (Cameron, 1986; Flood; Senge).

The frequency of, and changes in thematic patterns combined with the significance of patterns caused by the critical variables and archetypical systems relate to building or diminishing capacity. Complex Adaptive System Theory states that these variables and archetypical systems become thematic patterns, which occur from actions by 'agents' with other 'agents', within organizations, resulting in variations in outcomes known as schema (Dooley, 1996). These variations in schema of Complex Adaptive Systems are predictable, because these agents follow 'rules' based on a series of decision-making options (Anderson, 1999; Dooley; Holland, 1975; Staber & Sydow, 2002).

## Parameters for the Resource-based Model

The structure for evaluating the thematic patterns of resource utilization within strategic categories that composes an education delivery system is a derivative of Porter's (1985) generic value chain depicted in Figure 1. As a model, Macintosh and MacLean (1999) describe the generic value chain as a "Structure – Conduct – Performance Model" (p.298). Porter defines the value chain concept as "not a collection of independent activities, but a system of independent activities" (p.48) that are dynamically interrelated.



**Figure 1. Representation of an Education Delivery System as a Generic Value Chain**

## II. LITERATURE REVIEW

The literature review for this study consists of three distinct components. The first component is a summary of the literature, methodology, data analyses and findings from the three previous studies of the research project (Simpson et al.

2007; Simpson, Kite, & Gable, 2008a; Simpson, Kite, & Gable, 2008b) that integrate into the methodology to assess of district performance.

The second component of the literature review is a transitional phase. It returns to the end-point of the knowledge strand of Production Function research to examine the potential relationship between the quality of school-based variables and performance. Hanushek (1971, 1986, 2003, 2004, 2005), Hanushek, Raymond and Rivkin (2004) and Rivkin, Hanushek and Kain (2005) repeatedly present the alternative argument to the quantity of inputs as the determinant of school-based student achievement, which is that the quality of resources is an equal, if not greater influence on student achievement. Quality refers to the teaching and learning process, and capabilities of the teachers to optimize student achievement. The difficulty with understanding the influence teacher quality as it relates to student achievement is that it is difficult to measure. (Hanushek, 2005; Rivkin, Hanushek, & Kain, 2005). Review of this literature bridges the quantitative analyses of the previous sequences with the qualitative approach of this study by connecting to the essential concept that instruction is centric to performance.

The third component of this review is research literature that applies relevant portions of the knowledge domains from Microeconomics and Complex Adaptive System theories that support the proposition of this study. This portion of the review relates directly to the theoretical framework of the research design for this study. The attribution of a theory to either Microeconomics or Complex Adaptive System theory can be blurred, because the theories intertwine. As a result of this

interrelationship, the sections are intended to extract the capacity-building essentials from each theory and concept.

### **Previous Studies of the Resource-based Model**

#### **Patterns of District Performance in Student Achievement**

The first sequence was an ex-post facto quantitative analysis of the relationship between the independent variable of socioeconomics and the dependent variable of district performance as a measure of student achievement. The methodology and findings were consistent with the *Coleman Report (1966)* and Gaudet's (2000) research about the relationship between socioeconomics and performance.

The research question for the first quantitative analysis was:

1. *How does the dependent variable of district performance as an indicator of student achievement relate to the independent variable of Income per Capita as a proxy for socioeconomic status*
  - a. *What is the range of variability between actual performance and regression -predicted performance?*

The data sources were from the Massachusetts Departments of Education and Department of Revenue. All of the data used in this study were public information. The sampling frame consisted of the  $N=328$  operating school districts in Massachusetts. The sample selection for the  $N=85$  districts was non-probability and purposive (Huck, 2008). The sample replicated Gaudet's (2000) "Middle Massachusetts districts concentrated in the demographic [socioeconomic status] middle of the state" (p.15).



The analysis consisted of a single regression. The independent variable was Income per Capita and the dependent variable was district CPI. The result of the analysis was a regression-predicted value for CPI. To establish variations in performance from the socioeconomic status variable, the predicted-value CPI was subtracted from the actual CPI. This is used as the primary indicator of variation in performance for the  $N=85$  districts used in the research project and the  $N=7$  districts for this study. The analysis was conducted with the z-values for actual, the regression-predicted and delta statistic. For 2000 to 2006, the coefficients of determination ( $R^2$ ) for the independent variable of socioeconomics and the dependent variable CPI for district performance ranged from  $R^2=.50$  to  $R^2=.79$  in ELA and  $R^2=.59$  to  $R^2=.86$  in mathematics. All of the coefficients of determination ( $R^2$ ) were significant at the 0.01 level as two-tailed test and the F-statistic exceeds the critical value.

**Range of Performance Data.** Gaudet (2000) indicated that the differences between actual and regression-predicted performance values ranged from “25 points above the expected score to 14 points below the statistically-predicted score” (p.16). In this sequence, the ranges between actual CPI and the regression-predicted CPI for  $N=85$  districts were documented as maximum and minimum z-values for the delta between the scores. These z-values were converted into a CPI scaled score for relative comparison with Gaudet’s (2000) findings Simpson et al. 2007).

In summary, the coefficient of determination ( $R^2$ ) for the relationship between the dependent variable of CPI for the district as a measure of student achievement and the independent variable of income per capita as a indicator of socioeconomics (Sirin, 2005) ranged from  $R^2=.49$  to  $R^2=.79$ . In addition, the maximum range of variation between actual CPI and regression-predicted CPI was 26.35, which consists of -15.85 to 10.52.

### **Resource Allocation after Controlling for Socioeconomics**

According to Pan, Rudo, Schneider and Smith-Hanson (2003), research on resource allocation is a recent knowledge domain that emerged from the education reform movement during the past twenty years. Their sample selection for the  $N=12$  districts was non-probability and purposive, designed to identify high-performance and improvement school systems based on student achievement. Findings from Pan et al. included evidence that different resource allocation patterns, both fiscal and human, existed between high and low performing districts. Similar patterns of differences emerged between improvement and low performing districts. In addition, a range of proactive measures were taken to identify and overcome barriers, known in this study as archetypical systems, to changes in allocation within improvement districts.

The research question for this analysis was:

*Does the independent variable of marginal resource allocation to functional categories in an education delivery system relate to the dependent variable of district performance as an indicator of student achievement?*

The study conducted by Simpson, Kite, and Gable (2008a) used a micro-economic methodology for assessing district performance as it relates to

resource allocation. It was marginal rate of substitution conducted with multiple regression analyses of data for 2005 for both ELA and Mathematics. The quantitative analyses assessed resource allocation efficacies, as measured by student achievement, within education delivery systems of  $N=117$  districts. The analyses was conducted with SPSS using the stepwise introduction of the independent variables of (a) percentage of districts' budget spent (b) administration; (b) regular education instruction, (c) special education instruction, (d) professional development, (e) instructional supplies, and (f) fixed costs to the primary correlate of socioeconomic status.

As expected, the results indicated the socioeconomic status indicator of income per capita was dominant, but the spending in the functional category of regular instruction can have a consistent relationship to student achievement, which provides insight beyond aggregate production function analyses. Prior to conducting each of the multiple regressions the assumptions of normality, linearity, homoscedasticity and independence of residuals were examined by developing plots of the standardized predicted values (i.e., the standardized residuals). Examination of the plots for English Language Arts and Mathematics data indicated that the assumptions were reasonable (Tabachnick & Fidell, 2001). The coefficient of determination ( $R^2$ ) for the independent variable of Income per Capita used as an indicator of socioeconomic status explained 58% of the variation in achievement in Mathematics. Adding the variable for regular education spending to the equation increased the explanation of variation by 2.6%, which was significant at the  $p=.007$  level. Again, we note that even though

the sample size can contribute to the significance of the findings, support was present for the ability of the instructional variable to contribute to enhancing the explanation of variation in Mathematics achievement. This  $R^2$  for Mathematics combined with the similar  $R^2$  for English Language Arts provided support for the consistency of relationship of the percent of resources allocation to regular education instruction to student achievement (Simpson et al. 2008a).

Operationally, even though there is the possibility of reallocation, there are significant limitations, because of the cost structures in education limit the opportunity for shifting funds among functional categories (Rothstein, 1997; Rothstein & Hawley Miles, 1995). In conclusion, this sequence contributed to this study by demonstrating that the cost structures in education limit the range of allocation options. Knowing these limits supports the proposition for this study, which is that resource utilization processes, rather than allocation, can relate to variations in performance. Cohen, Raudenbush, & Ball (2003) summarize the need for, but limitations of resource allocation “conventional resources are not a system of instruction, for they cause nothing if they are used or not used in particular systems of instruction.... the effect of resources depends both on their availability and on their use within those systems” (p.133).

### **Variations and Patterns of District Performance**

This sequence developed groupings of performance along a continuum of performance for the  $N=113$  districts using Hierarchical Cluster Analysis (Simpson et al. 2008b). Re-analysis of the data consisted of the same methodologies, but for  $N=85$  districts and adding data from 2006. “The objective of cluster analysis

was to find similar groups of [cases] where similarity between each pair was construed to mean some global measure over the whole set of construct characteristics” (Green, Carmone, & Smith, p.117).

The research question for this sequence was:

*What is the nature and magnitude of variations in district performance?*

Hierarchical Cluster Analysis was the technique used to develop patterns of similar performance by districts in this sequence. It clustered districts based on user-determined features. The user-defined input [feature] of this study was the difference between actual and regression-predicted CPI for 2001 to 2006. These six data points for each district were entered in as a single input. The purpose was to capture the patterns of longitudinal variation in performance. It was an iterative process that can use several algorithms for analysis. Based on the data and research question, this study conducted complete linkage clustering. Complete linkage is also known as the furthest neighbor clustering method, because it a dissimilarity model. The other methodology parameters selected in SPSS were Euclidean distance with standardized output. The purpose of this methodology was to develop clusters of the dependent variable of district performance CPI as it relates to the independent variable of socioeconomic status using the Income per Capita indicator (Sirin, 2005). The input consisted of the difference between actual CPI z-values and regression-predicted CPI z-values. The essential question was whether the district under or outperformed its socioeconomic status.

The output consisted of dendograms, which are two dimensional diagrams that represent the union at each successive stage of clusters analysis. The vertical listing of cases, which were the districts merely represent an ordering within clusters. Interpretation of hierarchical dendograms was based on the relationships between the rescaled distances of the cluster analysis, i.e., the longer the horizontal distance the greater the dissimilarity with the adjacent case or cluster.

### **Capacity**

The domains of Microeconomics and Complex Adaptive Systems often converge on the concepts and theories of organizational capacity. This section of the literature review is organized by the theories at this convergence. All of the sections are inclusive to the central proposition of the present study, which is that capacity-building is a function of performance as it relates resource utilization within the education delivery system. The purpose for this design of this section is to develop the theoretical underpinnings of a resource-based model. Porter (1991) states that, “the resource-based view of an [organization] is closely related to the notion of core competencies” (p.107). The transparency between the knowledge domains is stated by Eden and Ackermann (2000), “discovering and working with patterns - the systemic properties – not lists of competencies and distinctive competencies is absolutely essential. Rarely are the systemic properties revealed by the inter-relationships between competencies [and performance]” (p.13). The concept of core competencies is central to the proposition, assumptions and methodology of this study, because they are

almost entirely non-contextual, but are specific to the critical variables and archetypical systems used in this study. For example, the Concept Mapping process for a high performing district can have a distinct combination of core competencies that are very different from another equally high performing district. This reinforces that the value of the resource-based model synthesized in this study is its *use as a diagnostic process* rather than identifying features of various performance.

### **Microeconomic Capacity**

Production capacity is technical capacity that “summarizes the various technical possibilities for converting inputs, or factors of production, into the maximum possible outcome” (Friedman, 2002, p.320). Microeconomic capacity relates to the marginal rate of return. The total cost must remain less than the benefit from the last unit of production. According to Salvatore, the margin is the key unifying concept in microeconomics,

because of scarcity, all economic activities give rise to some benefits, but also involve some costs. The aim of economics is to maximize net benefits. Net benefits increase as long as the marginal or extra benefit from an action exceeds the marginal cost. Net benefits are maximized when the marginal benefit equals the marginal cost. (p.12)

Capacity can be expanded with technological change and the learning effect (Jackson, 1998; O’Day, 2003; Porter, 1985; Swieringa & Wierdsma; 1992; Teplitz, 1991). According to Levin (2002), within Complex Adaptive Systems “efficient utilization of resources, known as a Pareto optimal, can emerge from individual rational behavior” (p.4), which suggests there are efficiencies that can affect capacity.

Corcoran and Goetz (1995) link educational reform with capacity by proposing that, “researchers have been studying the design and implementation of educational reforms. One of the major set of issues concern the capacity of these systems to achieve the goal of helping all students reach high standards of performance” (p.27). They continue by suggesting variables of instructional capacity that consist of “[a] the intellectual ability, knowledge, and skills of teachers, [b] the quality and quantity of the resources available for teaching, and [c] the social organization of instruction” (p.27). Corcoran and Goetz relate this interpretation to the potential of capacity for Complex Adaptive Systems and the generic value chain theory (Porter, 1985) by stating that, ‘the quality of human capital and the level of the resources available can be viewed as defining the potential of the system, but this potential is unlikely to be realized unless [the critical variables are coordinated and optimized]’ (p.28).

### **Learning Effect on Capacity**

Jackson (1998) defines the learning effect as, “the relatively permanent change in skill, knowledge, or ability. This occurs mainly from practice or experience and partly from observation, training, or a variety of education. The result can be observed in the measured change in production” (p.132). Porter’s (1985) generic value chain typifies the dynamics of the learning effect within an education delivery system,

The cost of a value activity can decline over time due to learning that increases its efficiency. Learning is often the [ac]cumulation of many small improvements rather than major breakthroughs. Learning tends to vary with the amount of management attention devoted to capturing it.... The rate of learning is often subject to diminishing returns, and hence it may decline over time for some value activities. (p.73-74)



Learning rates can vary widely, which changes the shape and position of the learning curve. Argote and Epple (1990) suggest that variation in learning rates can be attributed to several factors that include, but not limited to “organizational “forgetting” [from] employee turnover, transfer of knowledge [barriers], and the failure to control other factors, such as economies of scale” (p.3).

### **Cumulative Learning**

Cumulative learning is the basis for Learning Curve Theory (Eden & Ackermann, 2000; Porter 1985; Swieringa & Wierdsma, 1992). The reason why cumulative learning is a key aspect to the critical variables of capacity is because it consists of feedback loops that link a hierarchy of learning to organizational towards achieving its aspirations (Eden & Ackermann; Senge, 1990). This linkage is a process of feedback loops that connect learning outcomes to both continuously higher levels of decision-making (Swieringa & Wierdsma) and can represent a stage in the organizational life cycle (Cameron & Whetten, 1981).

As a variable of performance, there is a distinct archetypical system imbedded in cumulative learning, which is the attrition of human resources, which can reverse gains (Ostroff & Schmitt, 1993). Swieringa and Wierdsma (1992) develop a hierarchy of learning that is used as the scale for Concept Mapping in this study. In organizational learning, the learning curve manifests itself with feedback loops. The lowest order learning is a single loop can result in changing the rules that can affect behavior that improve results. A double loop affects the decision-making process with new information that renews processes, rules, behavior and results. The highest order of learning is a triple feedback loop,

which affects the principles and beliefs of the organization, which leads to overall development of the organization.

### **Collective Learning**

Cumulative and collective learning are related, because the concepts converge at the life cycle of an organization. Swieringa and Wierdsma (1992) model collective learning within organizations and provide a substantive definition in the terminology of competencies. They suggest that “competence is not determined only by what people can do [skills], what they have the courage and will to do and who they are [personality and attitude]” (p.19). Staber and Sydow (2002) connect learning to dynamic realities for organizational improvement by identifying the structural challenges of adaptive capability by stating that it can have “ambiguity and complexity, with contradictions that are difficult to manage and payoffs that are rarely immediate. The challenges of managing adaptive [capability] are evident in the tensions [that are] inherent in the structural properties which are multiplicity, redundancy and loose coupling” (p.409).

### **Innovation**

Economic theory literature uses innovation and technological change interchangeably. According to Jackson (1998), technological change “is any change in knowledge about production: methods of production, products, or inputs” (p.14), that is generally derived from innovation. There are two types of technology change. “A neutral change increases the quantity of output in relation to inputs, or reduces to quantity of inputs in relation to outputs” (Jackson, p.20). He continues to explain that it is a capital-labor substitution that “shifts the

production function down, but does not change the elasticity of output or input” (Jackson, p.33).

Jackson (1998) states that “non-neutral [technology] leads to an enhanced rate of labor productivity growth and labor productivity growth tends to be faster” (p.18). It produces “Capital-using and labor saving that increases the partial elasticity of output with respect to the capital input” (p.60). Non-neutral technology results in systematic improvement that is not gained from neutral technology. In this study, the hierarchical scale of innovation is used as the scale for Concept Mapping.

### **Social Capital**

Capacity does not occur in a vacuum of schools as closed-loop systems (Stone, 1997). The only context that is irrefutable is that schools are part of, and affected by their community and parents (Honig, 2006). Research has established that school improvement cannot rely solely on the resource utilization within the education delivery system to build capacity (Elmore, 2005; Gold et al. 2004). Despite the self-selective phenomenon of the relationship between schools, parents and community, it is a legitimate variable of performance (Robinson et al. 2003). As a component of Complex Adaptive theory, parent and community involvement can enhance, and sometimes degenerate, the core learning process. It is uncertain and insignificant to this study whether this involvement is considered as an external or internal variable. For this study, parental and community-based resources are included based on the assumption that community-based resources whether they are financial or non-financial

affect the value of resources. Unless the community is fully mobilized, which is not common in the literature, the more reliable estimation of this variable is Social Capital theory, which Robinson et al. (2003) relate to education by suggesting that, “the solution is not to reject localism altogether, but to acknowledge the problem and to rethink where responsibility lies for developing or providing the requisite levels of capacity” (p.263). Lastly, Gold et al. (2004) propose that correlations exist between student achievement and strong social capital in schools. In summary parental and community involvement is a factor, but it can be bivalent. This factor is represented by the secondary activity external stakeholder relationships in the generic value chain depicted earlier in Figure 1 on page 8.

### **Complex Adaptive Systems**

Corcoran and Goetz (1995) suggest that reform based on capacity building has made education more complex with the uncertainty of internal and external contexts. Elmore (2005) provides support for the need for a systematic and theoretical framework for understanding the complexity of education when describing an approach often taken in reform efforts, “pushing hard on a few strategic places in the system of relations surrounding the problem and then carefully observing the results” (p.29)

The framework for this study is Complex Adaptive Systems theory. Levin (2002) provides an overview of Complex Adaptive Systems theory when he states, “that observations of nature is the theoretical basis, but the notion Complex Adaptive Systems theory is expressed in everything from cells to

societies, in general with reference to the self-organization of complex entities across scales of space, time and organizational complexity” (p.3). Anderson (1999) provides the rationale for using Complex Adaptive Systems theory as a framework stating that, “Modern complexity theory suggests that some systems with many interactions among highly differentiated parts can produce surprisingly simple, predictable behavior, while others generate behavior that is impossible to forecast, though they feature simple laws” (p.217). Wheelan & Williams (2003) suggest that the emergent patterns in Complex Adaptive Systems are straightforward, because despite the many interactions between agents [people and groups of people] there are relatively few key variables.

The patterns that develop from actions by agents with other agents are schema (Dooley, 1996). These schema have strength and nature in the patterns produced by the actions of agents, which are predictable, because these agents follow rules based on a series of options (Anderson, 1999; Dooley, 1996; Staber, & Sydow, 2002). Holland (1975) explains the process of agents selecting options by suggesting, “discovery of the optimum a long, perhaps never-to-be-completed task, so the best among *tested* options must be exploited at every step. At the same time uncertainties must be reduced rapidly, so that knowledge of *available* options increases rapidly” (p.1). Morel & Ramanujam (1999) provide the argument for using a framework as part of an empirically-sound methodology when they state, “Appearance of patterns which are due to the collective behavior of the components of the system....The emerging properties are independent, observable and empirically verifiable patterns” (p.279).

## **Systems-thinking**

Senge (1990) popularized, contemporized and expanded on early concepts of the systems-thinking as it relates to learning organization concepts developed by Agyris and Schön in the 1970s (Flood, 1998). Conceptually, Systems-thinking begins to operationalize Complex Adaptive System theory to organizational behavior. Even though this study acknowledges Senge's approach to Systems-thinking as a method to apply Complex Adaptive Systems theory to education delivery systems, some of the Senge's processes and archetypes lack empirical evidence. The elements of this shortcoming of the strand are excluded if they cannot be aligned with theory. This strand is important to this study, because it bridges theory to application.

System-thinking as the fifth discipline is different from the other elements of a learning organization, because it is process dynamics rather than a characteristic. Senge (1990) depicts the process as circular consisting of action and reactive feedback, which are similar to the feedback loops of collective and cumulative learning. Senge's concepts are consistent with Complex Adaptive Systems theory, which are dissipative as a series of interrelated continuous circular processes. Senge suggests that there is two feedback or reactive processes; reinforcing and balancing. He describes reinforcing as "(or amplifying) feedback processes [as] the engines of growth" (p.79). Balancing feedback is "(or stabilizing) feedback operates whenever there is a goal-oriented behavior" (p.79). Delays influence the affects the outcomes of the cycle and can be bidirectional.

Flood (1998) reanalyzes Senge's (1990) categories of structures, called archetypical systems that are both points of leverage and potential limits to capacity building. According to Flood, Senge identified twelve archetypical systems, but only elaborated on nine. Consistent with Complex Adaptive Systems theory, the leverage points of these archetypical systems can produce patterns of outcomes that can be predicted by a range of behaviors. These archetypical systems consist of, "(a) Corrective Action with Delay, (b) Eroding Goals, (c) Limits of Growth, (d) *Tragedy of the Commons* (Hardin, 1968), (e) Growth and Underinvestment, (f) Treating Symptoms, Not Fundamental Causes, (g) Corrective Actions that Fail, (h) Escalation, and (i) Success to the Successful" (Senge, p.261-263).

### III. METHODOLOGY

#### **Concept Mapping: Convergence of Theories**

The methodology assessed in this study was Concept Mapping. Concept Mapping is a process that can be used for longitudinal multivariate assessment of an organization's performance (Dumont, 1989). It "is essentially a system for linking the high-level strategic view of the forest with the more specific operational view of the trees" (Trochim, 1998, p.2). The map shows the interrelationships between high-level strategic categories derived from operational variables. This study utilized the representation of an education delivery system as a generic value chain (Porter, 1985), depicted in Figure 1, as a template for the concept map structure. The generic value chain was the structure of the resource-based model, which "abstracts the complexity of

[resource utilization] by isolating a few key variables whose interactions are examined in depth. The normative significance of each model depends on the fit between its assumptions and reality” (Porter, 1991, p.97). The focus of this resource-based model was thematic patterns of resource utilization within and among each activity with instruction being the centric activity (Elmore, 2005). Conceptually, “resources are intermediate between the categorical activities and [performance]” (Porter, p.109). In the Concept Mapping process, these variables must be related to the achievement of the organizations goals (Cameron, 1986). Even though education has an array of goals, the primary goal in this study was district performance as an indicator of student achievement as measured by CPI on standardized assessments. This was the primary focus of the audits conducted by Massachusetts Office of Educational Quality and Accountability (EQA), so the organizational aspiration that was evaluated aligns with the nature of the data used in this study.

### **Sample**

The sample selection process for the  $N= 7$  districts was non-probability and purposive. The districts were selected based on their position a continuum of performance that was developed in the third sequence with Hierarchical Cluster Analysis, which clusters districts with similar performance longitudinally from 2001 to 2006 and separately for English Language Arts (ELA) and Mathematics (Simpson et al. 2008b). Each district was selected because of some unique performance characteristic.



An overview of the characteristics of the district is:

- a. A1 was a moderate-to-high performing district that has exceeded its socioeconomic status in both ELA and Mathematics, but to a greater degree in Mathematics. Even though district A1 has out-performed its socioeconomic status, it has been static in actual CPI growth.
- b. B8 was identified by EQA as a high performance district. It was the most affluent district in the sample. It has consistently exceeded its socioeconomic status, but to a greater degree in ELA. The actual CPI scores have been static in ELA and Mathematics
- c. G25 was the poorest district in the  $N=85$  districts in the sample frame for this research project. Gaudet (2000) identified the district as a noteworthy performer in his single year study. The district has outperformed its socioeconomic status in both ELA and Mathematics all years. In addition, G25 has had actual CPI growth.
- d. H30 has a slightly lower Income per Capita than A1, and has had mixed results in performance with no clear trend even though it has shown nominal growth in actual CPI. The district was unique, because it has consistently had a close 'fit' to the linear model for both ELA and Mathematics for the dependent variable of CPI as it relates to the independent variable Income per Capita.
- e. S63 was in the second quartile for Income per Capita, but was in the upper quartile for all years in both ELA and Mathematics. It could be a hyper-performing district, except that the growth in actual CPI was inconsistent.
- f. W81 was almost the mirror performing district to S63. It was in the second quartile for Income per Capita, but has significantly and consistently underperformed. The paradox for W81 was that it has fairly consistent growth in actual CPI in both ELA and Mathematics.
- g. W82 was in the bottom quartile for Income per Capita, and has underperformed its socioeconomic status all years in both ELA and Mathematics, but can be considered a turnaround district. Each year W82 has improved its performance and was the only district with a distinct positive pattern of improvement in actual CPI.

### **Instrumentation**

Concept Mapping is generally developed from input of stakeholders, but comprehensive narrative data from extensive observations have been

successfully used for the methodology for some evaluative applications (Trochim, 1998). The narrative data for this study were obtained from operational audits conducted from 2002 to 2005 by the EQA. The audits investigated six elements of education, which were, (a) leadership, governance and communication, (b) curriculum and instruction, (c) assessment and program evaluation, (d) human resource management and professional development, (e) access, participation and student academic support, and (f) financial and asset management effectiveness and efficiency.

### **Concept Mapping Process**

Trochim (1985) identifies six steps for conducting Concept Mapping, (a) preparation, (b) gathering data, (c) structuring data, (e) representing [plotting] the data, (f) interpretation, (g) utilizing the results. Preparation consisted of developing the focus to conceptualize. This focus of this study was the research question, which is what were the nature, strength and underlying relationship of thematic patterns of resource utilization within education delivery systems that relate to capacity-building? The steps for gathering data, structuring data and methodology for plotting the data were in the Instrumentation section.

The Concept Mapping methodology for this study consisted of two steps. The first analysis disaggregated the generic value chain as representation of the education delivery system into the individual activities. Individual matrixes were developed within the activity for the thematic patterns associated with the critical variables and archetypical systems. Except for linkages, the critical variables were assigned positive values in the matrixes (Trochim & Visco, 1986). Linkages

were represented by proximities between functional activities in the generic value chain (Trochim & Cabera, 2005). Archetypical systems have a negative value (Senge, 1991). The values that were assigned in the matrixes relate to the contribution of thematic patterns of resource utilization to an effect on instructional capacity (Trochim, 1985). The conceptualization of instructional capacity was indexed to the quantitative performance from the third sequence of the research project, which was the Hierarchical Cluster Analyses in Appendix C (Simpson et al. 2008b). These values were conceptualized in each matrix by the x-axis of frequency, the y-axis of significance and a z-axis for capacity. The z-axis was depicted by the size of the sphere for each construct. To capture the greater significance of primary activities the value assigned to a critical variable or archetypical system was weighted in a 3:1 ratio with the secondary activities for the z-axis that represented capacity. These axes were conceptualizations of the nature, strength and underlying relationship of thematic patterns of resource utilization within education delivery systems that relate to capacity-building. According to Trochim (1998), this follows principles of, and was a method of program evaluation and planning.

Probably the most difficult step in a planning or evaluation project is the first one -- everything which follows depends on how well the project is initially conceptualized. Conceptualization in this sense refers to the articulation of thoughts, ideas, or hunches and the representation of these in some objective form. In a planning process, we typically wish to conceptualize the major goals and objectives, needs, resources and capabilities or other dimensions which eventually constitute the elements of a plan. (p.1)

### **Reliability: Multi-trait – Multi-method Matrix**

Each activity in the generic value chain had at least three matrixes developed by highlighting the narrative information from the EQA reports. These matrixes

were developed from thematic phrases, key-words, inferential patterns, structural codes, terminology of the auditors and audit design. The purpose of developing multiple matrixes for each activity was a reliability technique known as the Multi-trait – Multi-method Matrix approach. (Davis, 1989). “The rationale for using the Multi-trait – Multi-method Matrix approach for construct validity was that if methods were independent and traits were accurate in their assessment, the relationship among traits should stay the same across different methods” (Davis, p.32). The multi-method component of this approach was that the different coding methods were built into independent matrixes. The relationships among traits were verified and the mean of the matrixes were used to develop concept maps. The “correlation coefficients between the trait and method interrelationships” (Davis, 1989, p.35) ranged from  $r=.71$  to  $r=.78$ , which is above the acceptable range (Davis).

Examples of the key word and phrases for pattern of descriptors include consistency, beliefs, accountable, culture and lack of. Each word or phrase can be bivalent. An example of this bivalence was the words consistency or inconsistency. The types of verbs were clearly dichotomous along action or passive category. It is important to note that significant cross-over occurred between the matrixes. For example, the overall tone of the EQA report was critical for districts G25 and S63, but the frequency of teacher-based statements that were active and consisted of some reference to a common belief or commitment was significant. In contrast, district W81 received a good report, but the verbs were passive and related to planning by administrators. Strands of

connectivity, or lack of, consisted of indicators of linkages between the activities in the generic value chain or a programmatic initiative. For example, as indicated by the performance data from the Hierarchical Cluster Analysis, district A1 had good performance in ELA, but inconsistent outcomes in Mathematics. During the review, interviewees from administration to classroom teachers cited the implementation of an improvement effort in Mathematics. Process indicators focused on the vertical and horizontal integration of a pattern of resource utilization, and any archetypical system that was a barrier.

The second step toward conceptualizing the thematic patterns of resource utilization as they relate to capacity was to re-aggregate the analyses of the activities into a composite generic value chain. The composite concept map uses the mean values for the critical variables from each activity for the x-axis and the mean values from each activity for the y-axis. The difference between the sum of capacity from critical variables and the sum of capacity for archetypical systems was the value of the z-axis, which is capacity, and was represented by the size of the sphere. This re-aggregation of the generic value chain was consistent with the principles of structuralism, which include “the whole is greater than the sum of the parts” (Gall et al. 2007, p.523). Re-aggregation was also consistent with the intended use of the generic value as a resource-based model, which Porter (1985) defines “not a collection of independent activities, but a system of independent activities” (p.48).

## **Data Analysis**

To develop the plots of the data in a concept map each thematic pattern of data in the matrixes that represented a critical variable or archetypical system were assigned a range of values 1 to 100 for each activity. Trochim (1998) explains "what the standard score means when we use the 0 to 100 scale was the degree to which we achieved the ideal or "best case" performance" (p.19). The x-axis values in the matrixes were on a positive 1 to 100 scale, because frequency for both critical variables and archetypical systems was a positive value. The y-axis values in the matrixes were on a 100 scale that was from -50 to 50. Negative significance was assigned to archetypical systems, and positive to critical variables.

### **Parameters for Evaluating Critical Variables and Archetypical Systems**

The criterion for assigning a value to a critical variable related to its characteristics. Cumulative learning values were assigned based on the hierarchy of feedback loops and evolutionary stages of the organization (Eden & Ackermann, 2000; Jackson, 1998; Porter 1991, 1985; Swieringa & Wierdsma, 1992; Teplitz, 1991). Collective learning was scaled by the range across the organization that a decision about resource utilization that it extends. Innovation was approximated by the distinction between neutral and non-neutral improvements (Cameron, 1986; Gaziel, 1996; Ostroff & Schmitt, 1993). Social capital relates to a range between passive participation by the community to the phenomenon of civic capacity (Bergstrom, et al.1988; Gold, et al. 2004; Honig, 2006; Shipps, 2003; Stone, 1997). The criterion for assigning a value to

archetypical systems relates to the apparent limitation for a critical variable to increase capacity. Each archetypical system related to any of the critical variables. For instance, competency traps can relate to cumulative learning if the decision was based on thematic outcomes that do not increase capacity (O'Day, 2002). Primary activities in the generic value chain were assigned higher values, because these activities can directly enhance or disrupt resource utilization as it relates to instructional capacity. The values assigned to secondary activities in the generic value chain have a limited range, because the activities can only enhance or reduce the effectiveness of a primary activity indirectly.

#### **IV. FINDINGS**

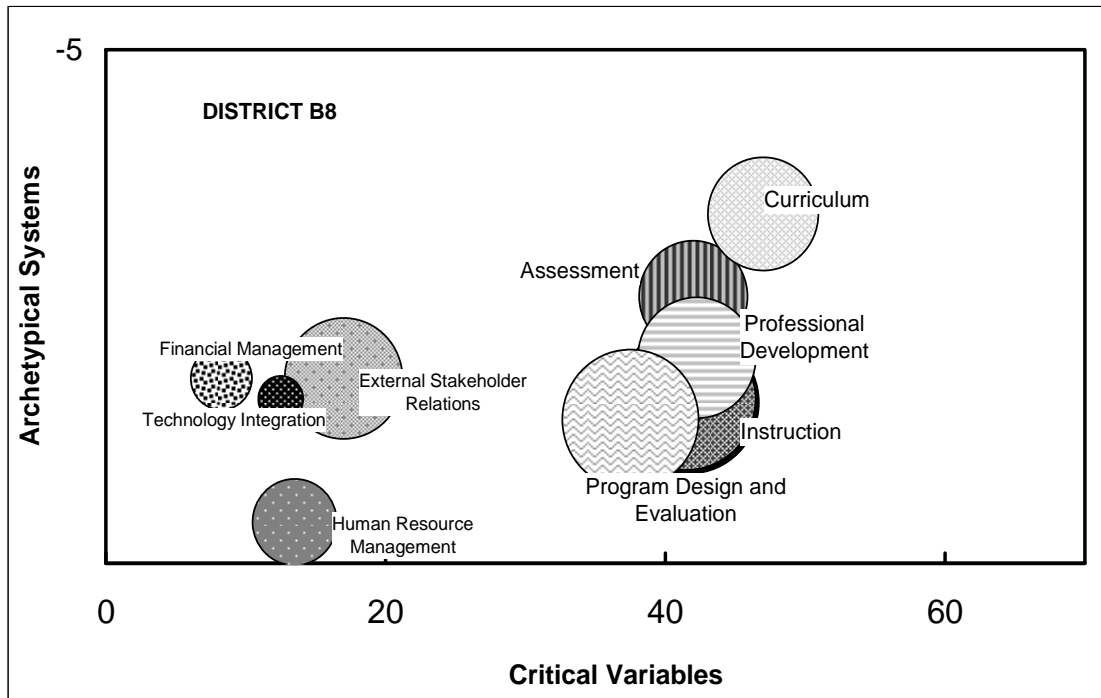
The purpose of using concept mapping in this study was to identify thematic patterns of resource utilization that relates to instructional capacity. Interpretation of the concept maps provided the frequency, significance, strength, and underlying relationships between the functional activities. When interpreting the concept maps for each district, the lack of apparent structure when compared to the generic value chain, should be viewed as a resource-based model that relates the structure of the generic value chain to the organization of processes that occur – the generic value chain and concept map complement each other rather than conflict.

##### **Interpreting the Concept Maps**

Interpreting these concept maps was based in Graph theory (Tatsouka, 1986). The primary aspects of the theory that was applied were cliques, isolates, and point basis as a representation of scope of influence. Each map was a

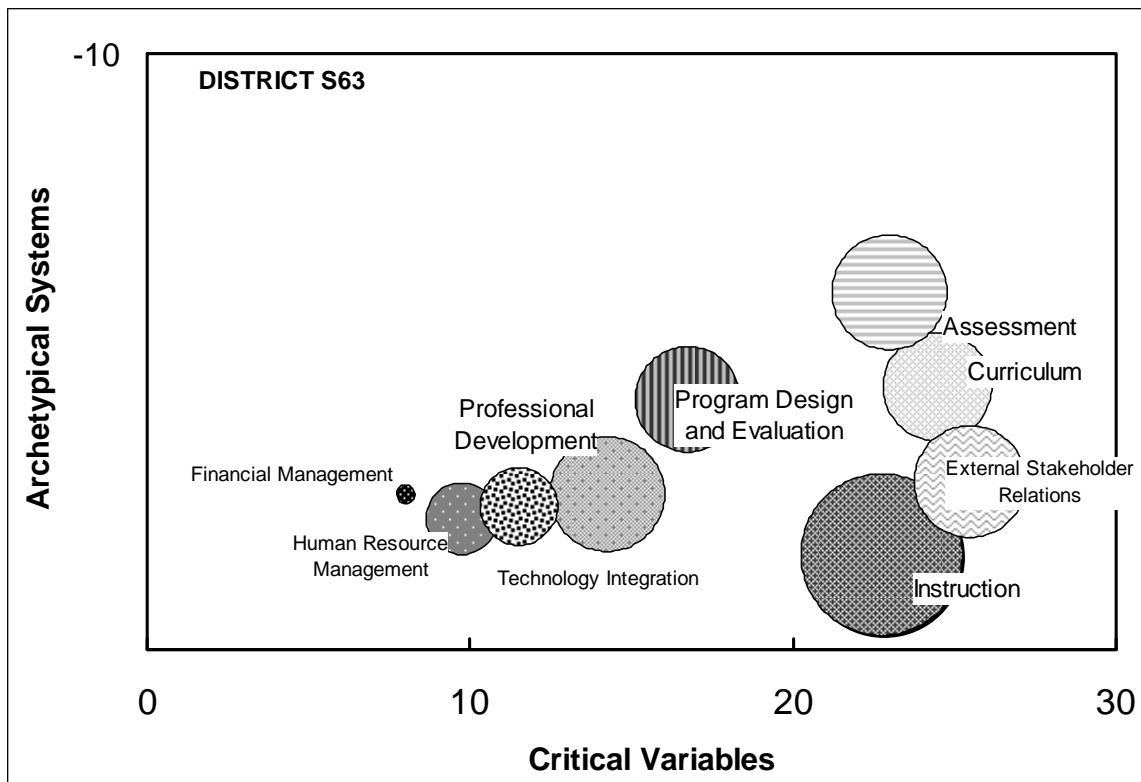
composite of the mean values for frequency and significance for an activity in the generic value chain (Porter, 1985). The capacity delta was the difference between the sums of the critical values and archetypical systems for each activity. The maps were a three dimensional representation of the education delivery system as a non-sequential generic value chain (Porter). Interpretation was based on inductive reasoning (Trochim, 1985; Trochim, & Cabera, 2005). based on relative position to, and size of the instruction sphere. Interpretation of the position of any sphere was centric to the instruction sphere (Elmore, 2005). Even though the size and position of any sphere was a representation of the resource-based model for the district, there was little to no commonality among the characteristics of that lead to size and position. Interpretation of the size of the instruction sphere relates to the strength and magnitude of instructional capacity. The position of the sphere for each activity was an indication of the thematic nature of that activity relative to the instruction sphere. This interpretation is prevalent in the two higher performing districts B8 and S63. Overlap of activities indicates linkages that occur between the connected activities. These overlaps can be interpreted as a principle of structuralism, which include “the whole is greater than the sum of the parts” (Gall et al. 2007, p.523). These linkages and the relative position of a primary activity to the instruction sphere appear to indicate synergies between and alignment of the primary activities (Lyons, 2004; Porter, 1985). This relationship among activities is a clique. This interpretation is prevalent in Figure 2, which is the concept map for district B8.





**Figure 2. Concept Map for District B8**

A primary activity that was an isolate from instruction indicates that there was unrealized potential for instructional capacity (Hord, 1997; Jackson, 1998). Even though district S63 is a high performing district, the activity Program Design and Evaluation is an isolate, which is an indication that there is separation in the potential capacity to instructional capacity. It is also significant that external stakeholders, which is a secondary activity is part of the chain of primary activities. This can be interpreted as social capital, and even civic capacity contributing to directly to instructional capacity (Stone, 1997).



**Figure 3. Concept Map for District S63**

Even for districts with similar performance, such as B8 and S63 depicted in Figures 2 and 3 each district expressed a different combination of thematic patterns of resource utilization for both critical values and archetypical systems. It is important to note that these concept maps have different scales. This was done for graphic clarity since the scales were only relative to the district. Interpretation of these concepts maps reveal the district B8 has a tight-configuration and overlap among the primary activities. An interpretation of this pattern reveals alignment of activities as the underlying relationships. Ideally, the closer the proximity between and among the primary and secondary activities can be interpreted as linkages that could create synergies between the critical

variables, or if the district is underperforming it can be indicative of negative synergies among archetypical systems.

Once a pattern occurred within an activity, it often was repeated in other activities. This is consistent with Complex Adaptive System theory, which indicates that the stakeholders in decision-making will follow a set of rules resulting in predictable outcomes (Cameron, 1986; Eden, & Ackermann, 2000; MacIntosh, & MacLean, 1999). The EQA data were for 3 – 5 years for each, which provides the opportunity to assess growth or decline in capacity. All districts with the exception of W82, which was characterized as a turnaround district, displayed repeating thematic patterns of resource utilization. District B8, which was a high performing district displayed triple-loop cumulative and collective learning patterns (Lyons, 2004). Each time a decision was operationalized, it was at the next level of resource utilization, which can be described as an upward spiral. Conversely, all of the decisions made by district W81 were characterized as passive planning with little indication that any implementation.

### **Moderating Variables**

There appeared to be three intervening variables that affect the predictability of the resource-based model. The first was leadership, which appears to follow the theories presented by Burns (1978). In high performing districts, such as A1 and in the turnaround district W83, leadership appears to be transformational. In the under-performing districts such as H30, leadership appears to be transactional.

The second moderating variable was culture as it relates to the teachers. This culture appears to manifest itself as an esprit-de-corps among teachers. The

most prevalent examples were districts S63, and especially G25. Data from interviews with teachers indicate that they understand, and act independently of administration, the relationship between alignment of teaching practices and student achievement. Despite the socioeconomic status challenges, the teachers in district G25 appear to function as the instructional leadership for the district, and even unilaterally redirect resources among the district. This is consistent with the findings of Rudo (2002) that indicate teachers understand the leverage points for instructional capacity.

The third moderating variable was a paradox within the research project that was revealed and validated by this study. The variable was socioeconomic status as it relates to the context of each district. This was a different manifestation of the socioeconomic status variable used in the quantitative analyses conducted in the first three sequences of the project. It was a qualitative dimension of the variable. The variable was dependent on the economic phenomenon of self-selection by residents of the community and an apparently lesser degree to teachers. Based on the data from this study, this form of socioeconomic status was a determinant of the types of opportunities and challenges confronting a district. The most dramatic contrast can be observed between districts B8, an affluent community, and the poorest district G25. District B8 created momentum to high performance from a higher starting-point than district G25. It would have been incongruous with this variable for district B8 to be anything but high performing.

## **IV. SUMMARY, CONCLUSION and RECOMMENDATIONS**

### **Summary**

Based on triangulation between the *á priori* quantitative performance data from previous sequences and the qualitative findings of this study, the resource-based model of district performance contains empirical evidence that thematic patterns of resource utilization within the generic value chain relate to instructional capacity (Trochim, & Visco, 1986). This empirical evidence derives from the theoretical constructs of capacity within the Complex Adaptive System theory framework (Anderson, 1999; Levin, 2002). These constructs display predictable behavior based on the decision-making rules that were specific to a district as an educational delivery system. The nature, strength, and magnitude of these thematic patterns of resource utilization have infinite combination possibilities, but the rules of the organization limit the possible schema for each district (Foster, 2004; Staber, & Sydow, 2002). This related to the fundamental premise of this study, which was that that any resource-based model will always been limited by context. Practices of high performing districts were not transferable to another district. The proposed application and any potential transferability of the resource-based model have always been intended for diagnostic purposes only (Sammons et al. 1995).

The resource-based model developed in this study does not presume to fully explain the variability in performance that was not accounted for by the independent variable of income per capita as a proxy for socioeconomic status. This study proposed that the three moderating variables of leadership, teacher

culture and qualitative socioeconomic status cannot account for all of the remaining variability either.

### **Conclusion**

Reliance on quantitative modeling for resource utilization as it relates to performance as measured by student achievement will remain indeterminate (McDermott, 1976). In this study, the research project synthesized a resource-based quantitative and qualitative model that developed a qualitative model that the National Resource Council proposed in 1999. Given that resource allocation is limited by regulatory and cost structure constraints (Rothstein, 1997; Rothstein & Hawley Miles, 1995), this study found that resource utilization within an education delivery system does relate performance. The key to modeling resource utilization as it relates to performance was to identify the key variables (Porter, 1991). Even though this model may not be the answer to resolving indeterminacy in resource decision-making, it was based on empirical evidence from Microeconomic and Complex Adaptive System theories. A caveat, not previously mentioned, but implied by Gaudet (2000) is that resource utilization is not necessarily fluid decision-making, but can be entrenched within a district's culture.

### **Recommended Use of the Resource-based Model**

The use and application of the resource-based model synthesized in this study was further qualified by three additional delimiters, (a) availability and focus of consistent data sources, (b) development and interpretation of the concept maps, and (c) the different variations of thematic patterns that can produce

similar outcomes. This study was possible because of the availability concurrent data that focused on performance. The independent audits conducted by the EQA limited bias that was found in self-evaluations. Regardless of the reliability of multi-matrix multi-trait methodology, development and interpretations of the concept maps was inductive and subjective, and should be validated by replication and peer review. Lastly, the study revealed that the various combinations of critical variables and archetypical systems into thematic patterns was almost limitless using the measures of this study, which were frequency, significance and affect on capacity. In the theoretical framework of Complex Adaptive System theory, the predictability of outcomes was more probabilistic than determinant (Antonacopoulou, & Chiva, 2007; Dooley, 1996).

A recommended application of the resource-based model synthesized in this research project as method to reduce indeterminacy in decision-making at the district-level. The diagnostic value of the model stands apart from its potential impact on sustainable changes in decision-making. Even with the information that the model can provide to decision-makers no assumption should be made that it will cause change. A realistic point-of-entry for the application of the model is in strategic planning after the stakeholders in a district have already decided that change was necessary.

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