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SETTING PUBLIC POLICY USING SYSTEM DYNAMICS AND CAUSAL LOOP DIAGRAMMING:

A CASE STUDY FROM A COMPETITIVE PUBLIC UTILITY

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INTRODUCITON

This paper describes the usefulness of systems thinking and causal loop diagramming in the development of public policy in a competitive public utility. This paper is based upon actual work performed in 1995 and 1996 at Cleveland Public Power in Cleveland, Ohio. This paper covers only the linkage between the systems thinking /causal loop diagramming and the formulation of public policy aspect of the work. Please refer to Pegasus Communication's Innovations in Management Series article, *Transformational Dialogue: The Reinvention of a Public Utility* (Ramadan, Parker-Roach and Klempner 1998) for a more detailed treatment of the overall effort and the broader organizational learning aspects of the approach.

The paper is divided into three distinct section:

- Introduction

  In addition to this structural explanation of the paper, this section introduces the reader with the general context in which the work was conducted.

- The Group-Based Construction of a Causal Loop Diagram – By Patrick Parker-Roach, Consulting Member of the Society of Organizational Learning and Vice President of Technology Solutions Company

  A causal loop diagram of the 'governance' environment of CPP was constructed as part of an organizational assessment conducted under the sponsorship and guidance of CPP's commissioner. The causal loop was jointly developed by a group of 35 CPP employees and contractors as part of this assessment during a series of facilitated meetings. This section of the paper describes the mechanics of the facilitation's that yielded the diagram.

- A Dynamic Framework for a Governmental Competitive Utility – By Nagah Ramadan, then Commissioner of Cleveland Public Power and current Executive Vice-President of RCC Consultants, Inc.

  Governance issues, in situations where you have governmental entities competing with private entities are, to say the least, complex and problematic. This section describes some of the dilemmas that the Commissioner of Cleveland Public Power faced in setting a strategic direction for his utility, and how systems thinking and causal loop diagramming helped.

CONTEXT OF THE WORK

Cleveland Public Power (CCP) is the municipal electric power company for the City of Cleveland, Ohio. Since it was founded in 1908, CPP has been locked in a bitter, competitive battle with an investor-owned electric utility, Cleveland Electric Illuminating Company (CEI), of First Energy Corportaion. The two companies compete on a street-by-street, house-by-house basis. In fact, it is not unusual to see two sets of power poles lining the same street. Historically, CPP has serviced the older neighborhoods within Cleveland proper, while CEI has serviced the northeast Ohio neighborhoods and the more lucrative commercial and industrial accounts.

In 1987, CPP, funded by a large bond issue, embarked on a program aimed at expanding CPP's coverage across the City. As a direct result of this expansion effort, CPP's service area expanded from 35% to nearly 50% between 1987 and 1995. Although the physical effort of putting up poles, stringing cable, and putting meters on homes progressed well, CPP began feeling the growing pains of the expansion. Although customer demand through the expansion effort proved high, customer satisfaction ratings fell. CPP's operating systems and organizational structure simply could not keep pace with the company's expanding power delivery system and increases in customer demand.

In February 1995, the mayor of the City of Cleveland appointed a new commissioner to address CPP's problems. During his first month on the job, the commissioner embarked on a major transformation effort to address the performance issues. He also realized that he needed to maneuver CPP into a better position to meet another looming challenge: deregulation of the electric power industry.

CPP's effort was a systemic one, involving the complete redesign of core business processes and the creation of an information technology architecture that would support the new processes. The design and execution of this effort unfolded in an unusual context of competitiveness *and* public ownership with unique accompanying cultural and political implications. The change effort also took place amid intense uncertainty stemming from the impending deregulation of the industry.

We can think of CPP's reinvention effort as consisting of two main stages: assessment and transformation. The assessment effort was conducted over a two-month period, March_April 1995, and resulted in an action plan for the actual transformation of CPP. It was in the context of this assessment that a causal loop diagram was constructed to help in setting a strategic course for CPP.

THE GROUP-BASED CONSTRUCTION OF A CAUSAL LOOP DIAGRAM

BY PATRICK PARKER-ROACH

Given the political forces swirling around the public power industry, the competitive environment, and looming deregulation, CPP would have to effect its transformation speedily. To meet this challenge, Commissioner Ramadan decided to engage the entire organization in the reinvention process. His rationale was that if CPP wanted to achieve *sustainable* transformation, the people who would have to implement it and live with the results would need to embrace that transformation. The team included a complete cross-section of CPP's population. It included management and line worker representatives from each major function; Customer Service, Trouble, Engineering, Maintenance, Marketing and Sales, Meter Reading, Computer Operations, Engineering and Design Contractors, Personnel, and Administration. Other demographic and cultural attributes were also considered to ensure a balanced cross-section was achieved; gender, union membership,

civil service membership, seniority, etc. CPP also engaged two outside process consultants, Carl Klempner and Patrick Parker-Roach, to guide the team through the assessment effort.

SETTING THE STAGE

There were a couple of things that were done at the outset of the project to prepare for the actual assessment.

First, the facilitators constructed a cultural assessment questionnaire and used it as the basis for one-on-one interviews with the 35 participants of the assessment team. The individual interviews were confidential. However, a summary of the findings was prepared and fed back to the interviewees as a group. The purpose of the interviews was to get a general "lay of the land," uncover a sense of the culture at CPP, and reveal any "landmines" that might be lurking just under the surface of the organization. The interviews also gave the team members an opportunity to vent feelings and articulate any hidden pressures or concerns that might have been building.

Second, we conducted the Beer Game with the team. In a fun but very real way, the Beer Game demonstrated how structure drives behavior in organizational settings. It showed that even the best-intentioned efforts to optimize a group's performance can lead to sub-optimal performance by the whole organization. This shared understanding of the connections between structure and behavior set a tone in the group away from placing blame, and towards the sharing of thoughts and ideas openly in a group setting.

Armed now with a solid understanding of the norms, behaviors, and other cultural forces at play at CPP, the team designed a plan for assessing the organization's current situation. The plan called for five two-day meetings over five weeks, a schedule that would balance the need for speed with the necessity to keep the organization running. It was the first three of these sessions, the Current State Analysis, which yielded the causal loop diagram.

ANALYZING THE CURRENT REALITY

This phase involved analyzing how work was actually accomplished by CPP's approximately 22 functions. The analysis relied heavily on wall-charting techniques carried out in a large conference room that had plenty of free wall space. Using colors, symbols, text, and the physical positioning of cards on the walls, the team captured information and ideas in a visually accessible way. The wall-charts became a natural form of documentation for the project, and proved an excellent vehicle for bringing new team members up to speed quickly. More experienced team members could walk a new person around the room and use the charts to tell the story of the "journey" so far. The wall-charts also facilitated communication by helping the team members avoid misinterpretations or overly emotive language. In this way, the charts contributed to an environment that encouraged openness and a sense of safety. As a result, team members focused their frustrations on the wall-charts, and not on each other.

"Analyzing Current Reality" involved four distinct steps which led up to the causal loop diagram;

- Detailing Functional Activities,
- Analyzing The Workflow,
- Performing A Root Cause And Consequence Analysis,
- Synthesis Of The Causal Loop Diagram.

These four activities are detailed in the following sections.

DETAILING FUNCTIONAL ACTIVITIES

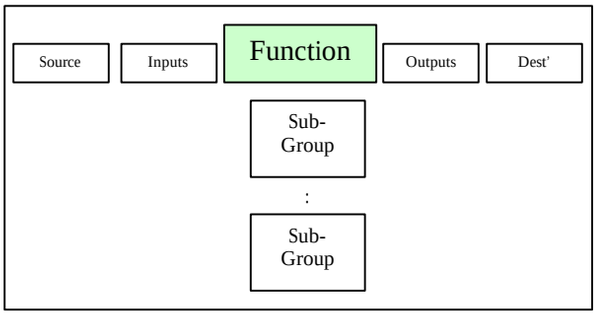
The Mechanics:

During this exercise, we distributed a large number of white 3x5 cards to all participants of the room and prepared them for an open dialogue relative to all of the work that is accomplished at CPP in the delivery and sale of electrical power to their customers. We instructed them to capture all of the various tasks on the 3x5 cards; one activity per card. We encouraged them to write any activity that came to mind no matter if it was; performed within their function or not, whether it was at a high level or low level of granularity, whether they thought someone else probably wrote it or not. We explained that it was a self-leveling exercise, and that the generation of ideas was the main point.

Once completed, we performed an affinity exercise with the data. The exercise was structured around the existing functions within CPP. We had prepared in advance by writing the names of all 22 internal functions on green 3x5 cards. We posted the green function cards on a large wall. We directed the team to place their white cards under the appropriate headings (affinitize). We further instructed them that it was quite all right to move any card on the wall from whatever heading it might be under to the heading under which they thought it belonged. If a card moved back and forth between two functions often enough, the card was duplicated and placed under both functions.

When the team activity came to a halt, we had people ‘sign-up’ to do a refinement of one or more of the functional groupings that emerged on the wall. This evolved into about 10 teams, each responsible for about two functions.

The task that they were assigned was to take all of the cards under a function and further 'affinitize' them. Unlike the previous exercise, where we told them what functions to group items under, we now told them to group the cards in natural grouping; i.e., activities that tend to go together. This exercise generally tends to produce 4 to 6 sub-groupings. Once the sub-groupings were made, we had them name each. A generic example would be a Sales function with sub-groupings of activities with names like – Take Orders, Process Orders, Do Credit Checks, Generate Work Orders, etc.



Next, each team was provided a flip-chart with a template to follow. The template looked like the top row of the figure at the right. We instructed the team to label the function (Sales from the example above) and place each sub-grouping under the function (Take Orders, Process Orders, etc.). Then, for each sub-group the team was directed to label the chart with the things that a sub-group activity needed to do the activity (Inputs), where they came from (Source), what the activity produced (Outputs) and where the outputs go (Destination). Additionally, we asked them to label anything on the chart that they thought was good or done real well (green arrows) and anything that was problematic (red arrows).

The Outputs:

This exercise produces a number of outputs that are used in the next exercise:

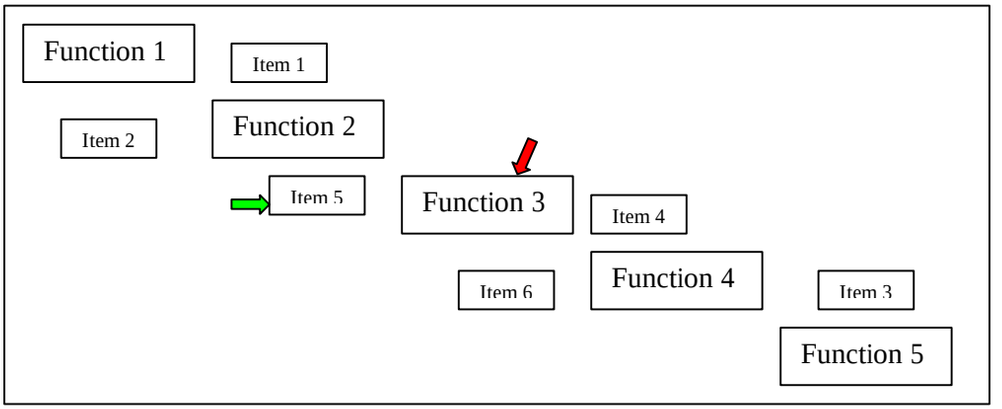
- A common understanding, and language describing, what goes on within a function amongst the team members
- A description of the linkages the functions have with each other
- And, a list of those things the team thinks are done well, and those things they think are done not so well. Typically, teams usually identify those things they produce as things done well, and those things which they receive to do their work as something less than perfect!

ANALYZING THE WORKFLOW

The Mechanics:

Armed with the outputs from the previous exercises, representatives from each function presented their respective charts to the entire team describing the nature of their work. They then described the inputs to, outputs from, and work within their particular function.

During these presentations, the speakers built yet another wall-chart to show how their inputs and outputs linked up with other CPP functions or with outside entities such as customers, regulatory agencies, and so forth. This chart is referred to as a diagonal matrix. It was built on the fly during each function's presentation. Refer to the following chart. Notice that the functions are placed on a diagonal from the top left to the bottom right. At CPP we started with 22 functions and then added entities as necessary (customers, unions, etc. – Any entity that interfaced with CPP). As each group presented the inputs to, and outputs from, their respective functions, those inputs/outputs were placed on the chart (Items on the chart). The key to building and reading a diagonal matrix is as follows. Outputs from a function are on the function's horizontal axis (left or right); in our example, Items 4 and 5 are outputs from Function 3. Inputs to a function are on its vertical axis (above or below); in our example, Items 1 and 5 are inputs to Function 2. The beauty of the diagonal matrix is that you can graphically depict an any-to-any mapping between any number of entities (functions in our example). Another nice thing about the diagonal matrix is that if the need to add another function is identified during the presentation, another function card can be added at either end of the diagonal at any time.



In addition, the speakers recorded their function's successes (green arrows) and internal problems (red arrows), and their feelings about the other functions on which they relied. As the speakers talked, audience members had the opportunity to relate their feelings in kind. Not surprisingly, this exchange generated a tremendous amount of energy in the room. The group also gained vital new insights and lessons. As a result of this sharing of information and feelings, the team arrived at a holistic, integrated view of the organization.

The Outputs:

This exercise produces a number of outputs that are used in the next exercise:

- The entire team gained a shared understanding and language to describe how work actually was accomplished within CPP. It was a real eye-opener for some employees who had been with the utility more than 25 years. They stated that this was the first time that they had seen how the whole thing came together and they were only on their second day working as a team!

- After the dialogue that ensued, there was consensus in the group on what and where the major problems (symptoms) facing CPP lied, both internally and externally. This kind of declarative analysis makes it very difficult to hide any issues.

- Likewise, core competencies of the organization came to the surface.

ROOT CAUSE AND CONSEQUENCE ANALYSIS

During the previous exercise real and perceived problems and competencies rose to the surface. The team now used Ishikawa fishbone diagramming techniques to uncover cause and effect relationships. Using these techniques the team was able to uncover the real underlying causes of the problems. At the same time, the effect analysis exposed the true costs to CPP (in money, service quality, time, customer satisfaction, etc.) of the organization's various problems. Understanding true costs proved enormously valuable. The team used these insights later to decide how to allocate their energies in designing solutions.

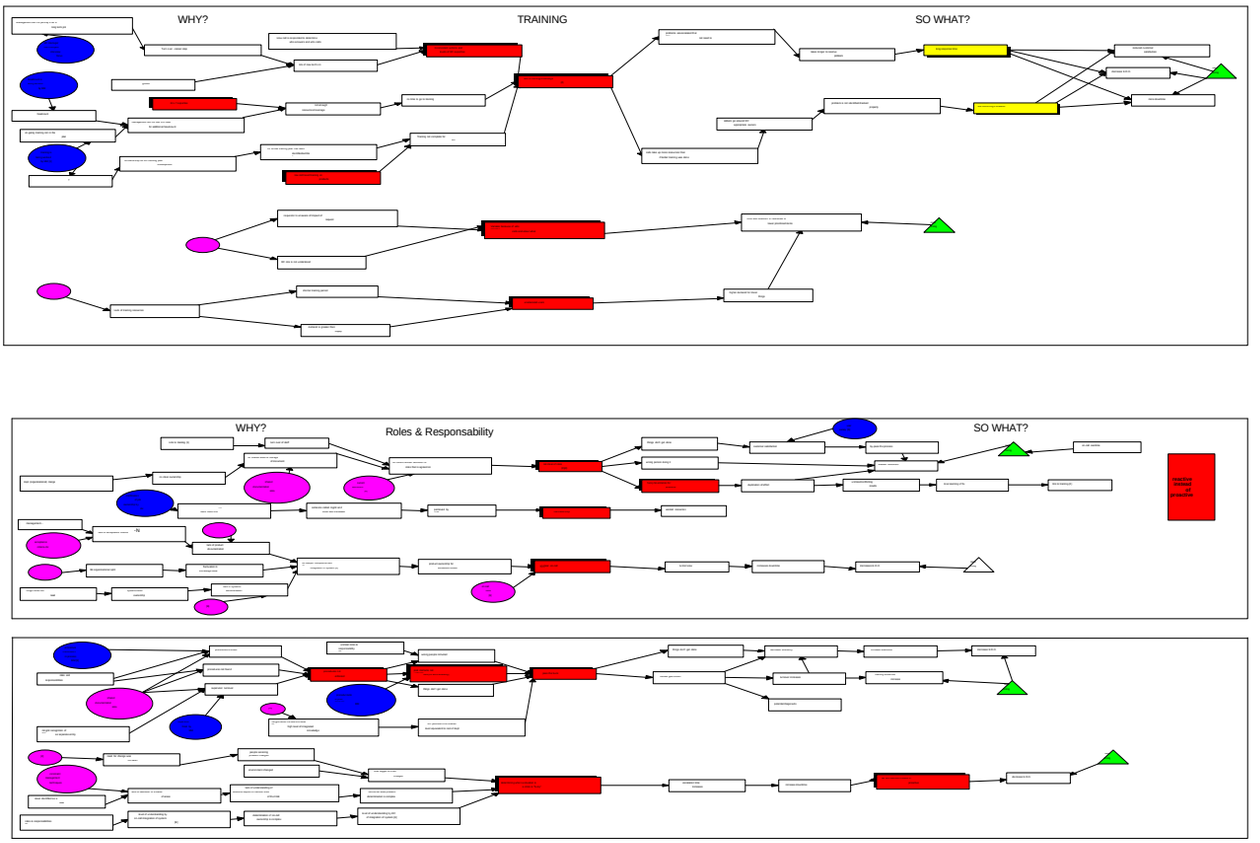
The Mechanics:

The team was directed to copy all of the red (problems) and green (competencies) arrows onto 3x5 cards with one problem or competency per card. There are typically one to two hundred cards on a diagonal matrix. Once done, the team placed all of the cards up on a large wall. They then sorted the cards into 'like' groupings. Typically, an organization will find between seven and fifteen of these groupings. Once the groupings are stable, the team subdivides itself based upon where individuals have energy relative to the major groupings. The sub-teams then name the major groupings. If there are a significant number of cards in one of the groupings, the team may be asked to further subdivide and name the sub-groupings.

This is typically a significant moment for teams. When they see hundreds of red arrows on a diagonal matrix, they seem to get overwhelmed by the volume of troubles that they have. A sort of mini-depression can set in if you do not move them through this quickly. Once all of those cards are condensed into seven to fifteen bullets, people tend to feel much better. That number can fit on a piece of paper, and the first impulse is to go off and attack those items. However, now is the time to remind people that those items represent seven to fifteen symptoms, not the root causes of the symptoms.

The second step of this exercise is to analyze the symptoms and get to the real root causes, and their consequences. First the root cause.

The sub-teams are assigned one or more of the problem groupings to analyze. The technique is to take a problem (red rectangle in the following figure) and ask “Why is this a problem?” five times. The following diagram depicts 3 root cause and consequence analyses. It is a well known and documented technique in TQM circles, and will not be discussed in detail here. The one thing to remember though, is that when the team identifies what they believe is a root cause, have them document any ideas on how to remedy the problem right then, while the analysis is fresh in their minds. In the case of these diagrams, the good ideas are shown as lavender and blue ovals.



Now, a less well known technique is performed that is called a consequence analysis. It is very similar to root cause analysis and is also shown in the above figure to the right of the rectangular problem boxes. In this case, there are two significant differences. First, instead of asking “Why”, we ask “So what is the consequence of this problem?” The second significant difference is that we do not ask the question five times. We ask the question as many times as it takes to bring the analysis to a *measurable* outcome; lost revenue, decreased quality, employee turnover, etc. The measurable outcomes are indicated by the green triangles at the leaves of the consequence trees.

The Outputs:

This exercise produces a number of outputs that are used in the next exercise:

- This is a very difficult piece of work for the teams. It takes a lot of energy on everyone's part to complete it. Because of the effort involved, everyone gains a true appreciation for the underlying dynamics of the problems. Much more so than if someone (a suited consultant, for example) was to just present their own findings to them.

- The true costs and implication to CPP emerged. They were able to easily identify those problems which were just 'squeaky wheels' and those that had profound implications to their success as an organization.

- The team had evolved the foundations of a management dialogue, instantiated in the root cause and consequences charts, that proved invaluable in justifying their recommendation to the Mayor when they presented to him.

- An identification of the major variables, inside and outside of CPP, business as well as political, that were driving business results.

CAUSAL LOOP DIAGRAM SYNTHESIS

At this point the discussion becomes somewhat anticlimactic. In structuring the data as we had so far, it was a fairly straightforward to synthesize an initial causal loop diagram of the environment at CPP.

The Mechanics:

The root cause and consequence diagrams are constructed on wall charts. They are completed by sub-teams working in parallel. When completed, each sub-team presents their work to the entire team. As the wall filled up with root cause and consequences charts it became apparent that the consequence of one analysis would turn out to be the root cause of another. As a team, we noticed the connections and knew that the complexity of the interactions of these connections would make meaningful analysis near impossible unless we could find a new way of representing the connections.

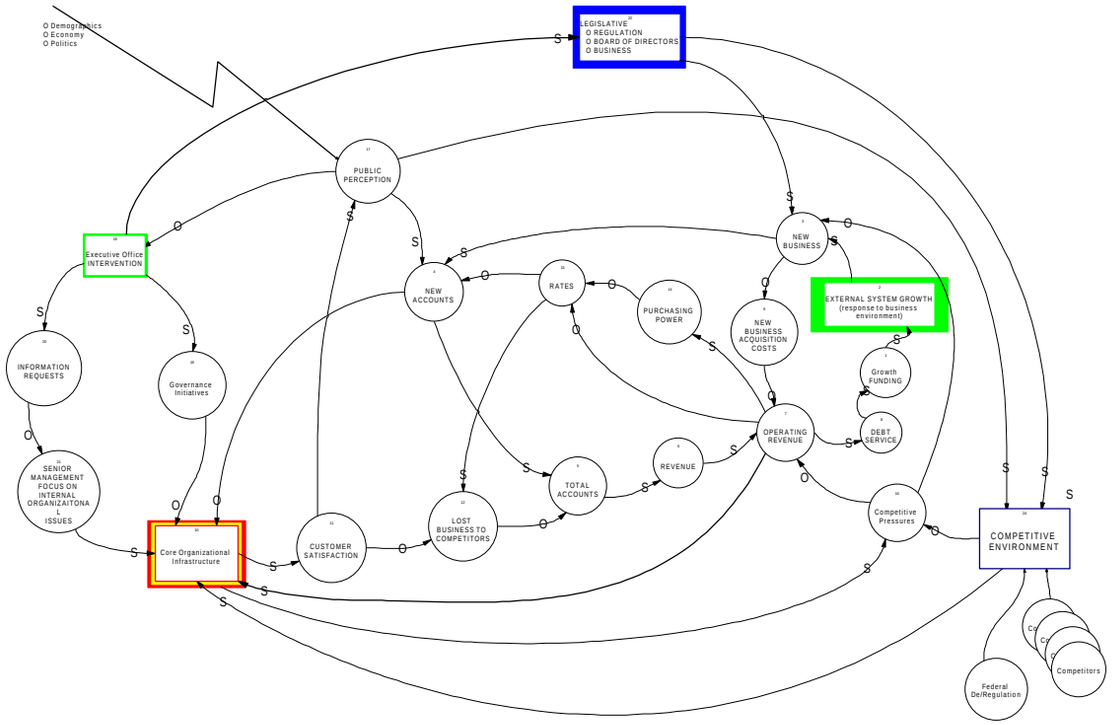
The work was taken off line and connections between the key variables were made using bits of twine to make the links. This new model was moved into a graphical computer model. The creation of a causal loop diagram was not an explicit or implicit goal of the work at this time. It was the visualization of the connections that made it apparent that with a little work a causal loop model could be evolved to help understand the workings at CPP at a much deeper level.

It was with the aid of the Commissioner, who had deep private insights into the political and competitive environment fueled by impending deregulation, that the final form of the diagram was realized. It evolved through the telling of stories around the diagram. Sustaining and opposing loops started to emerge, as the stories became richer. Some variables were dropped, while others not thought of were added. As with all useful causal loop models, this one too is evolving with time.

The Outputs:

The following is a sanitized version of an early version of the model. A more detailed one is not provided due to the competitive nature of CPP's business environment.

An Open Systems Model of a Governmental Entity Within a Competitive Environment



This concludes the Group-Based Construction of a Causal Loop Diagram section of this paper. Nagah Ramadan completes this paper with a discussion of how this approach aided him in developing a model for governance and A Dynamic Framework for a Governmental Competitive Utility.

A DYNAMIC FRAMEWORK FOR A GOVERNMENTAL COMPETITIVE UTILITY

BY NAGAH RAMADAN

This paper addresses the issues of governance, administration, and politics that affect the outcomes of municipal governments in delivering their goods and services while competing in the market place with private industry. Furthermore, it expands upon the issues of governance by addressing the dilemmas and paradoxes of a governmental bureaucracy functioning in a competitive environment under the restraints of the American Constitutional doctrine of separation of powers. It touches on the paradoxes a public administrator faces in bridging the gulf that separates the bureaucratic stability and rigidity from the dynamics of a changing business environment, using the electric utility industry as an example. This industry is currently on the verge of a fluid era of deregulation similar to that being experienced by the gas and telecommunication industries. And this paper, in due course, prescribes a dynamic framework for a competitive governmental utility. It explains the interactions between the Executive Office, the Legislative Branch, the competitive governmental agency, a dynamic business environment, and the public perception and what impacts it. It concludes with a prescriptive model that illustrates the components and associated interaction of a competitive government utility.

By taking the oath of office, the public administrator of a competitive governmental agency ingests a razor blade that he can neither swallow nor can he spit out. He has to manage paradoxes, tenuous situations, and choose among difficult choices and competing alternatives of ends and means. In the due course of discharging his responsibilities, he must bring to bear his knowledge of managerial, political and legal theories and processes to fulfill executive, legislative, and judicial governmental mandates for the provision of the services and regulatory functions for the society as a whole or for some segments of it [1]. Also, with the popularity of government providence of public utilities services, he must borrow the power of each of the underlying base disciplines and his hard-won experience and tacit knowledge to formulate useful tools to deal pragmatically with ambiguity, uncertainty, complexity, asymmetry of information, differing values and distinctive views of the individual citizen, and change.

PARADOXES OF PUBLICLY OWNED CPP AS A COMPETITIVE ENTERPRISE

The Charter of the City of Cleveland vested the City Council as the legislative power of the city; the executive and administrative power of the city is vested in the mayor, directors of departments, and other administrative officers. Each department of the city is divided into divisions. These divisions are established either by the charter or by City Council by ordinance, with the concurrence of the Board of Control. Also, the Board of Control was created, as the City's Cabinet, by the City Charter and consists of the mayor as its ex-officio president and the directors of the departments. The State of Ohio Constitution Article XVIII, know as the Home Rule Amendment which was adapted in 1912, gives the City of Cleveland, as a municipal corporation, the power to order its local affairs in its own way and prevents the State from dictating internal policy.[2] Also, Ohio Constitution XVIII-4 allowed municipalities to acquire public utilities or contracts from public utilities services. Furthermore, the Ohio Constitution XVIII-5 conditioned acquiring or operating municipal utilities

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1 Rosenbloom, David H., Public Administration Understanding, Management, Politics, and Law in the Public Sector, 3d. Ed., McGrawHill, New York, 1993.

2 See Froelich v. Cleveland, 29 CC(NS)49, 30 CD 493 (Cuyahoga, 1918), affirmed by 99OD376, 124 NE 212 (1919)

on ordinance such an act. The foundation of the City's current organizational structure goes back to 1931.

Cleveland Public Power (CPP), a public electric utility, is owned and operated by the City. It is a division of the Department of Public Utilities which belongs to the Policy Cluster that is headed by the Executive Assistance for Policy and Chief of Staff of the City's Administrative Branch. CPP exemplifies the paradox of a publicly owned and in the same time a competitive enterprise. It is an enterprise in a real competitive business environment. Its survival is based on its performance -- its revenue generating capacity. It is not supported through the general fund revenues, as it is the case of any non-enterprise city's agency. The paradox here is that CPP has to be judged according to its performance in the market place, while at the same time, it has been governed and controlled as a true government agency, by all the weight and rigor of the public bureaucracy. This dual and apparently sometimes conflicting role must be managed.

Another paradox is that CPP has to function both as an effective part of the government and as an efficient utility while maintaining its major competitive advantage - lower electricity rates. The paradox is in the balancing of being both responsive to the market dynamics and the transformational tremors of electric utility deregulation and partial deregulation looming on its business environment horizon, while being a governmental bureaucracy that is rule bound, impersonal, mechanistic and fastened by codified ordinances, formalistic, service-centered, socially moral and representative. It is a competitive business entity and must respond timely and effectively to its changing business environment. It must manage its function and deliver its outputs as a competitive enterprise within the confinements of the public administration -- legal-constitutional and political -- boundaries while enhancing its market position and adapting to the environment's dynamics whether business or cultural, social or political. As a competitive enterprise, it does have specific clearly defined goals. As a governmental and political enterprise, its high-level goals, the political directives, are vaguely defined and means-end cyclic. CPP is an anomaly in the traditional governmental environment. While CPP confronts door-to-door competition, the other city agencies enjoy a natural monopoly. CPP's customers have a choice to get their services from other competitors. While the customers of the other agencies have no redress, if such a need arises, against inefficiency, poor service, high rates and general disregard for their needs. Indeed, CPP is controlled by market discipline in addition to being governed by governmental cumbersome administrative and regulatory rules.

COMPETITIVE PUBLICLY OWNED UTILITY'S INTEGRATED APPROACH FOR CURRENT AND FUTURE CHALLENGES

The popularity of the privatization and the competitive approaches, that some municipal governments around the country are adopting, calls for a framework that captures the intricacies and interdependence of the public administration variables, especially when they are compounded by the complexity of actual competition. A dynamic framework helps in identifying the competitive environment of the governmental unit or agency. It highlights the important and continuously changing factors and the diverse choices available; and it provides choices among different courses of actions. Additionally, it helps in thinking through the appropriate interventions to be taken and the systemic consequential reaction. Furthermore, the dynamic framework that is developed in this paper contains models of the critical interacting variables, their consistent logical relationships, and their impact on the framework outcome.

The practical experiences, theories, and the empirical descriptions of how government units operate, how they are managed, governed, and controlled, and how they compete, are what this dynamic framework sets out to explain, and to provide choices and respective outcomes. It also helps

to understand the causal relationships of all the components in the framework. These components are: the Administration - the *Executive Office*, the Legislative branch- *City Council*, and the agency or the division competing in the competitive environment - the *CPU* of a municipal government unit. Additional components include the *Competitive Environment* and *Public Perceptions*. The *Competitive Environment* includes emerging and newly entering competitors, federal and state regulatory dictates, as dynamic inputs and influencing agents. The *Public Perceptions* are affected by external changing inputs, such as demographic and cultural shifts, political and social changes, constituents and stakeholders and private agendas.

The development of the theory that is embedded in this framework as reflected in the way the variables interact and their interdependence, their mutual reinforcing, retarding and balancing effects, and the parameters and structure that induce their dynamic behavior that affect the outcome will be the subject of another project. A graphic model is included in the next section - Sample Causal Loop Diagram Scenarios - to offer an illustration of how models within this framework function, in case of a CPU, and to answer questions such as: how a CPU responds to the changes in its business environments?; what are the responses needed from the framework building blocks?; and how can a CPU's internal structure be impacted? This graphical model representing the systemic behavior of the vital external systems to the CPU -- the Administration, the Legislative and Regulatory, and the Competitive Environment -- with narratives explaining the interactions between the major systems is included for reference.

Additionally, this model represents the business impact on the CPU's internal structure; reflects its responses and needed competencies; and guides decision making through considering the interrelationships among the framework building blocks. Additionally, while cognizant of the models limitation and abstraction, this was developed as an interactive one that lends itself to computer modeling for testing the business theory hypothesis, rethinking its continuous validity, simulating different scenarios to meet new challenges, and the testing of major changes in the business strategies.

One of the struggles encountered in developing this paper was in sharing all of the complexities associated with the framework. It became apparent very early that written language was not sufficient to convey the concepts. To overcome the shortfalls, the causal loop presentation was chosen to convey the complexity of interactions. The causal loops bring about a common language that illustrates the complexity of the systemic behavior of a governmental competitive utility, and brings about knowledge sharing and a common language. This approach is attributed to Jay Forrester. See, for example, Industrial Dynamics,(Cambridge, Mass: MIT Press, 1961), one of his pioneering works in the system dynamics approach. Narrative was added to explain the causal loop interactions

This paper has presented a comprehensive framework for describing a very complex and interdependent environment fraught with paradox in which competitive public utilities operate. The tools and mechanisms used to understand and come to grips with the complexity are elegant. They encompass a frame of reference to model complex theories for investigating courses of action and potential implications. However, it remains the duty of the administrative executive to take the utility's vision and transform it into a sustainable reality. This includes consolidating the interactions between power centers, actors, business environments, organizations and the public. The vision needs to be communicated and promoted, internally as well as externally, in soliciting the critical mass necessary to support it. The administrative executive must exemplify tenacity despite adverse conditions and create the social climate in which it can flourish.

EXTERNAL SYSTEM GROWTH PROGRAMS

START AT GROWTH FUNDING (1)

A Growth Funding (1) enables the External System Growth Programs (2).

More money in the External System Growth Program (2) enables more New Business (3).

More New Business (3) drives two loops which both meet at Operation Revenue (7).

SUBLOOP 1

More New Business (3) means more New Accounts (4)

More New Accounts (4) means more Total Accounts (5)

More Total Accounts (5) means more Revenue (6)

More Revenue (6) means more Operating Revenue (7)

SUBLOOP 2

More New Business (3) means more one time New Business Acquisition Costs (9) per account.

More New Business Acquisition Costs (9) means less Operating Revenue (7), unless it is financed throughout long term debt, which is more than offset by the above stated ongoing Revenue (6).

The increased Operating Revenues (7) means more ability to pay the Debt Service (8).

The ability to pay the Debt Service (8) means that the organization is in a good position to acquire more Growth Funding (1) and this is a *very positive reinforcing loop* and typically the original vision of an External Growth Program.

REDESIGNING THE CPU INFRASTUCTURE

Start at New Accounts (4)

The increasing New Accounts (4) caused by the External System Growth programs scenario has a negative impact on the Core Organizational Infrastructure (10) due to the increased burdens to support such increase without change in structure. This manifests itself in two major subloops which ultimately feed upon each other.

SUBLOOP 3

The over-stressing, due to the External System Growth programs, of the Core organizational Infrastructure (10) increases the Burden of Internal Systems (15)

The increases in Burden of Internal Systems (15) weakens the competitive capabilities which invites an increase in the number and magnitude of Aggressive Tactics by Competitors (16). This has two effects:

The Needs to Combat Aggressive Tactics by Competitors (16) causes a lowering of Operating Revenues (7) which in turn lowers the ability for the organization to invest in its infrastructure and again decreases Core Organizational Infrastructure (10) creating a vicious cycle.

The increase in Need to Combat Aggressive Tactics by Competitors (16) causes a decrease in the ability to have New Business (3) which in turn lowers New Accounts (4), Total Accounts (5), Revenue (6) and ultimately Operating Revenues (7). There are further implications to the decrease in Operating Revenues (7) that will be discussed when the next subloop meets this subloop at Operating Revenues (7).

SUBLOOP 4

The overstressing of Core Organizational Infrastructure (10) decreases Customer Satisfaction (11). This impact on Customer Satisfaction (11) has two main effects:

The decrease in Customer Satisfaction (11) lowers the Public's Perception (17) of the CPU, which in turn, lowers the number of New Accounts (4). This eventually ties back to Operating Revenues (7) as shown above. The lowering of Public Perception (17) also results in more Executive Office Intervention (18). This has two effects:

More Executive Office Intervention (18) causes more Priority Interrupts (19) to the organization which further reduces the Core Organizational Infrastructure (10) capacity to meet the needs of an expanded customer base; another vicious cycle.

More Executive Office Intervention (18) causes more Information Requests (20) to the organization's senior management causing a reduction in the Senior Management's Focus on Organizational Issues (21). This reduction in focus reduces Core Organizational Infrastructure's (10) capacity to met the needs of the expanded customer base; yet another vicious cycle.

The reduction in Customer Satisfaction (11) increases the number of Lost Business to Competitors (12) further reducing Total Accounts (5), Revenue (6), and Operating Revenue (7).

These two vicious cycles culminate in a reduction in Operating Revenues (7) which further exasperates the problem. The reduction in Operating Revenues (7) lowers the ability to pay the Debt Service (8) making it more difficult to get a further Growth Funding (1) to fund future External System Growth Programs (2). Additionally, the reduction in Operating revenues (7) directly impacts the organization's Rates (13). Indirectly, the reduction in Operating Revenues (7) negatively impacts the organization's Purchasing Power (14) making it more difficult to negotiate lower Rates (13) for its customers. The inability to offer lower Rates (13) reduces the organization's ability to attract New Accounts (4) and increases Lost Business to Competitors (12) and impacting Operating Revenue (7) causing further deterioration.

All of these loops and subloops combine to balance and negate the positive effects of the External System Growth (2) programs in a negative spiral. An appropriate intervention is the redesign the organizational infrastructure enabling it to respond to the additional demands of the External System Growth (2) programs.

LEGISLATIVE INTERVENTION

Start at Public Perception (17)

As Public Perception (17) of the Organization deteriorates due to the Customer Satisfaction (11), Executive Office Intervention (18) increases. If the nature of the Executive Office Intervention (18) took the form of legislation, Regulatory and/or Control, and Contracting and Rates Authorization (22) the following two subloops would occur:

SUBLOOP 5

Favorable Legislative Intervention (22) will decrease the Cost Per New Customer Acquisition (23) reducing overall related New Business Acquisition Costs (9) having an positive impact on Sales Revenues (7). CPU's positive Legislative Regulation (22) will open up new service areas for expansion allowing more New Business (3) helping to address the New Accounts (4) to Lost Business to Competitors (12) ratio.

SUBLOOP 7

Favorable Legislative Intervention (22) will help CPU's ability to meet Competitive Environment (24). Which in turn helps meet CPU's Needs to Combat Aggressive Competition (16). The reduced pressure will improve Core Organizational Infrastructure (10) which will result in increased New Accounts (4) resulting from the New Business (3) described in Subloop 5 above.

This Legislative Intervention coupled with the redesign of CPU's Infrastructure combine to support and enable the original goals and vision of the External System Growth (2) programs to meet the changing competitive environment.