On the emerging change patterns underlying the move from Mechanistic to Logic/Systems Models of Performance in the Public Sector

Abstract

This paper examines the origins and development of the “logic model,” which is used primarily in evaluation literature as a graphic depiction of the systems performance model with special emphasis on “program theory” or “theory of change.” It focuses on developments primarily in the United States and other English speaking countries. From approximately 1900 through the early 1970s, the examination of organizational performance in the United States reflected a concept of Input/Output, associated with, if not derived from, Scientific Management. Beginning in the mid-1950s, this concept transformed through the introduction of systems thinking and the systems model: Input→ Throughput→ Output. The systems model originated in the 1940s and spread widely during the 1950s.

Systems thinking has dominated the discussion of performance for the last half century and more. However, despite the simplicity of the core model, there is no single accepted variant of the systems model of performance. In current language, the systems model is known as the “logic model,” but, again, there is no single accepted variant of the logic model. This paper explores a variety of systems/logic models as they have been used in performance literature and as they have developed over time. Historical questions to answer are: Where does this model come from? How and when did performance thinking adopt this type of model? How complete is the merger between performance thinking and systems modeling?

Focusing more on the current era, the paper addresses the current stage of the evolution of the merger between systems thinking and performance modeling. It shows areas of incomplete alignment, suggesting development yet to come.

On the emerging change patterns underlying the move from Mechanistic to Logic/Systems Models of Performance in the Public Sector

At the beginning of the 21st century, performance measurement and evaluation have been closely associated with the “logic model” in many publications. Typically the logic model has three to five stages:

Input → Process → Output → (Individual) Outcome → (Societal) Impact

The first three stages, sometimes abbreviated to the second and third stages, are the core of the logic model. However, a significant use of the logic model is in the development of the fourth stage, which is sometimes divided into (H. Hatry, Houten, Plantz, & Greenway, 1996):

→ Immediate Outcome → Intermediate Outcome → Long Term Outcome

Only a relatively few discussions of the logic model include discussion of societal impact and the literature generally does not clarify the relationship between this linear model other typical performance constructs including efficiency, effectiveness, satisfaction, quality, or equity. The model is sometimes shown to exist in an open environment, thereby acknowledging, if not examining, external feedback, which is not distinguished from noise (Frechtling, 2007).

There is agreement that the terminology is traceable to Joseph Wholey (1979) and was popularized by the United Way (H. Hatry et al., 1996), and the Kellogg Foundation (C. C. Phillips, 2004). The point of this paper is to establish the history of the concepts that contribute to the logic model and to suggest further clarification and development.

The structure of this paper is: The next section of this paper examines the origin of the middle node of the three element logic model. The third section discusses some elements of early cybernetics and its diffusion. The fourth section discusses some aspects of early performance measurement, before any alignment of performance with cybernetics. The fifth section discusses the gradual incorporation of cybernetics within management, performance and some variants of evaluation. This section is primarily developed from an examination of diagrams and schematics within the academic literature. The sixth section discusses the advent of the "logic model." Section seven examines provides a discussion of the overall history and its significance. Section eight is a conclusion.

A limitation of this study is that it is developed largely from electronically identified graphic images of performance models. Electronic search for these images is a relatively new process and may be less than reliable. Still, images have been identified for every decade from 1950 to the current period, generally looking for captions that contain terms such as input, output, throughput, etc., and terms such as performance, evaluation, management, etc. The identified images are cited by page number within the text. The early discussion relates to a more general electronic search for the term "black box." The two databases searched are JSTOR and Google Scholar. Images are identified primarily in JSTOR. Another limitation of this study is that it is not an examination of the very likely parallel developments in management thought. This is particularly apparent in that some branches of management thought have much more sophisticated development of feedback constructs.

The Black Box

Before 1900 the two main uses of the term, "black box," were to designate a container of something precious – valuable papers, legal documents, evidence for a trial, diplomatic or businesses messages, manuscripts, money, jewelry, physician's supplies or lesser bric-a-brac – and to refer to a casket or a trunk (Browne, 1857, p. 11; "The Chamber of Death," 1827, p. 80; Defoe, 1724, p. 50; Dickens, 1881, p. 286; Dickens & Browne, 1853, p. 206; Eachard, 1685, p. 144; Fanshawe, 1702, p. 401; Maartens, 1890; Osborne, 1689, p. 35; Pepys & Wheatley, 1660, p. 91; Smollett, 1753, p. 184; 1756, p. 429; Stubbes & Berry, 1579, p. 205; Waller, 1870, p. 98). It was derivatively used to refer to attorneys (Bailey & Buchanan, 1760; Barrère & Leland, 1889, p. 125). Perhaps as an extension of the first usage, it sometimes referred to a prop for magicians or mediums (Dee, Casaubon, & Kelly, 1659, p. 167; Waite, 1890, p. 231). In this usage, and in a certain degree the usage with valuables, it took on a sense of mystery, curiosity or controversy, perhaps in part as a result of two tales of black boxes: one alleging a conspiracy by Jesuits against the royalty (Ross, 1641) and the other alleging a black box contained proof of marriage between Charles II and Lucy Walters that would have legitimated Charles' son, James, Duke of Monmouth, who mounted a rebellion and was executed after Charles' death (Betham, 1801, p.

291; Clarke, 1815, p. 599; de Thoyras & Tindal, 1731, p. 245; Dodsley & Chesterfield, 1821, p. 21; Hume, 1759, p. 297).

In the late nineteenth and early twentieth centuries, “black box” became associated with equipment: cameras, radios, microphones, “radio-phones,” devices for conducting psychological or visual experiments, laboratory specimen containers, and similar gear (Allen & Sachtleben, 1894, p. 54; Arey & Crozier, 1919; A. Black, 1899, pp. 41, 81, 99, 177; Blake, 1898, p. 53; "Carry Your Wireless Telephone With You," 1919; Clark, 1916, p. 471; Gotch, 1904, p. 18; Holland, 1898, pp. xiv, 3; Larkin, 1903, pp. 156-157; M'Kendrick & Colquhoun, 1906, pp. 839-840; Reeve, 1910; Russell, 1877, pp. 4-5; Schroeder, 1912, p. 605; Weidensall, 1916, p. 81; Wells, 1860, p. 148; 1901, p. 686; Yerkes, 1907).[1] The association was natural in that these types of equipment were often housed inside of boxes. From there, it migrated to use with motion pictures in the 1920s (Ramsaye, 1926). Implicitly, these new uses referred to the location of a process, which process to the uninitiated may appear curious or mysterious, almost magical. Throughout the early twentieth century, “black box” was associated with gradually more sophisticated equipment (N. H. Black, 1925; Neal & Perrott, 1922; Ranger, 1922). One special form of black box that is related to the usage here, but has taken on a special meaning, is the recording device in airplanes and (more recently) other forms of transportation, which is said to originate in the 1930s ("Flight recorder ", 2013 ; Richards, 1946; Suddath, 2009).

In approximately 1945 the term became associated with diagrams reflecting the unexamined process located between input and output:

[1] Uses omitted from this review include a type of plant, a type of apparel or fabric, a printing format used to emphasize content, and boxes that happen to be black.

Input → [Black box] →Output.

In its earliest uses, this diagram is found primarily in electrical engineering or closely related literature (Becker, 1950; Cauer, Mathis, & Pauli, 2000; McMillan, 1946; Richards, 1946; Sommers, Weiss, & Halpern, 1949; Wigner, 1949).

Cybernetics

A similar diagram arose in within a few years in the work of Claude Shannon (1998), which treats the linkages between nodes as channels and focuses on the relationship between noise (random non-information bearing electrical impulses on the channel) and information (the intended transmission from one node to the next) . In the 1940s these diagrams were applicable principally to the domain of mathematics, electronics and computers. By diagraming noise and information, Shannon was developing statistical information theory. At the same time, and with broad impact, Norbert Weiner (1948) introduced cybernetics, essentially a physicalist theory of teleology.[2] Weiner shows that a system can appear to be purposeful, that is, it can be self-correcting, through the use of feedback, for which he elaborates the mathematics as a theory of communication and control. These theories and diagrams come together as general system theory (Bertalanffy, 1951a, 1951b).

While developing foundations for computer theory and robotics, Weiner aims for a much broader audience involving biology, medicine, psychology, sociology, philosophy, management and beyond. For example, the claim that pure physicalist explanations of the appearance of purposefulness can further suggest that mind-body dualism (a common and extended philosophical topic) is subject to solution by reducing “mind” to body, with the idea that mental

[2] Teleology refers to causation where the cause follows the effect, purposeful causation.

phenomena are mere epiphenomena.[3] This suggestion led to discussion in a plethora of articles over the next decades, starting almost immediately (Cohen, 1952; Deutsch, 1951; Hofstadter, 1951; Negley, 1951; Pirenne, 1952; Taylor, 1950; Thomson & Sluckin, 1953; Wisdom, 1951).

In psychology, the cybernetic construct – and possibly the implied elimination of mind-body dualism – was attractive to some with interest in behavioral studies, which viewed the inner workings of the mind as opaque (a "black box") irrelevant to the matters of interest (socially acceptable behavior). Experimental psychology also sometimes used actual (black) boxes in experiments (Elam, Tyler, & Bitterman, 1954; Forgus, 1954; Hopkins, 1955). System theory showed that behavior could be viewed as an output product of signal and noise, with stasis maintained through feedback; and could be mathematically modeled (Boring, 1953; Mosier, 1955).

During and following the 1950s, the influence of cybernetics diffused to many disciplines including education (Watson, Rivlin, Jersild, Shoben, & McKillop, 1956), economics (Boulding, 1952; Knight, 1952; Macrae, 1951; Noyes, 1950), accounting (Moonitz & Nelson, 1960), medicine (Cohen, 1953; Ellis, 1953; Hubble, 1953), biology (Abercrombie, 1951; Stone, 1953; Waterman, 1962), sociology (Cadwallader, 1959; Leyton, 1959; Lundberg, 1960; Macrae, 1951; O'Donnell, 1950), anthropology (Keesing, 1960), political science (Kessler, 1957; Lasswell, 1955; Rice, Wilson, & Cook, 1950), and other disciplines. Depending on the exact form of influence – within some disciplines the initial response was more a reaction against cybernetics or a suggestion that Weiner (1950) was negligent in his foray into social science by failing to

[3] This explanation would appear to convert mental phenomena, such as the readers conscious understanding of this sentence, to the status of watching a movie and having no actual influence.

understand the disciplines he addressed (Macrae, 1951) – the diffusion sometimes led to a diffusion of the related mathematics and diagraming.

Two disciplines to which the concepts of cybernetics diffused that are of particular interest in this study are management and management science. Within management, cybernetics is associated with organizational theory (Bougon, Weick, & Binkhorst, 1977; Crozier & Thoenig, 1976; Ericson, 1970, 1972; Hall & Mansfield, 1971; D. A. Harrison & Klein, 2007; Hunt, 1970; Kilmann & Herden, 1976; Leifer & Delbecq, 1978; Litterer, 1966; Reimann, 1980; Scott, 1974). In some instances this association may lead to an inversion of the cybernetic organism-as-machine paradigm, following instead the traditional Hegelian machine-as-organism (organization-as-organism) model (D. C. Phillips, 1972). Cybernetics appears within the management literature frequently enough to have other influences as well, for example in both 1962 and 1964 it appears among recommended topics for inclusion in management curriculum (Hanika, 1962a, 1962b; Revans, 1964); presumably, in this respect, associated techniques are incorporated within the body of management knowledge.

Management Science/Operations Research (MS/OR) embraced cybernetics and its mathematical techniques early on (Smiddy & Naum, 1954; E. C. Williams, 1954a, 1954b). Boulding (1956) proposes that general systems theory can provide a framework for MS/OR. By the end of the 50s cybernetics was treated as a standard component of MS/OR curriculum (Kendall, 1958) and included in related textbooks (Swan, 1958).

Performance

Input and output were already known concepts for management and related economics; and to a degree, so too was process. Fredrick Taylor's scientific management focused substantially on process (worker productivity) and early management literature puzzled over process, but the associated performance literature discussed the economic concepts of input and output treating the matter more like a transaction. The early literature of performance measurement considers worker effort, but this is not a clear analysis of process (D. W. Williams, 2002, 2003). In 1925, process is implied in some early literature such as a table in the First Annual Report of the Board of Education for Librarianship (Strohm et al., 1925, p. 252), where inputs (enrollment) are compared with outputs (degrees and certificates), but also the intermediate condition (continuous enrollment) is reported. This form of this report continued until at least the Twelfth Annual Report (Metcalf et al., 1936). Another area where process was recognized during this period involved the schematics drawn with respect to physical plants, such as water treatment plants (Aultman, Kelly, & Hoover, 1939; Jenkins & Powell, 1957).[4] Other focused performance literature from this period examines efficiency, the ratio of input to output or its inverse, and puzzles somewhat over quality, but leaves process substantially out of the discussion (Glaeser, 1932, 1933; Ridley, 1927; Ridley & Simon, 1943).

Through the 1950s, 60s and into the 70s, performance literature, which became performance budgeting literature then productivity literature, continued to focus on productivity, the relationship between input and output (Batson, 1963; Beckman, 1964; Buck, 1949; Eghtedari & Sherwood, 1960; H. P. Hatry, 1972; H. P. Hatry & Fisk, 1971; Lind & Lipsky, 1971; Lytton, 1961; Parsons, 1957; Sherwood, 1954; Sykes, 1951; Vandermeulen, 1950; Zimmermann, Kroeger, & Stene, 1958). However, during this same period, the more sophisticated focus on the systems model developed in other related literature.

[4] The Hawthorne experiments in the 1920s also examine process.

Diagrams and Schematics

The Shannon schematic (reflecting inputs, coding, channels, noise, decoding, and output) spread to psychology (Pollack, 1953, p. 422), general communication theory (Bern, 1961, p. 189; Gerbner, 1956, p. 191), education psychology (McCreary & Surkan, 1965, p. 366). Black box schematics (input, process, output), spread to communication/information theory (Schouten, 1953, p. 200), psychology (Pollack, 1953, p. 425), computing (Sprague, 1952, p. 43), physics (Reich & Swerling, 1953, p. 3) and similar disciplines over the same period. Cybernetic schematics (which may include Shannon or black box components, but also include feedback), spread to such disciplines as biology (Bertalanffy, 1951b, p. 349), communications (Bushnell, 1963, p. 6; Ely, 1963, pp. 21, 22, 25), psychology (Baldridge, 1964, p. 641), education psychology (McCreary & Surkan, 1965, p. 366), and aeronautics (Smaus & Stewart, 1951, p. 18).

By the late 1950s, administrative literature sometimes included diagrams that bore a resemblance to the systems model. Douglass (1957, p. 67) adopts the linear diagramming approach where the input term is "exploration," the process is "analysis" and "discovery," and the output is "synthesis"; the diagram implies multiple channels for the relationship between analysis and discovery, which, in turn, suggests influence from Shannon; however, there are no citations to show this linkage.[5] Getzels & Guba (1957, pp. 429, 433, 436) look inside the black box adopting a systems model with two channels to examine the psychology of administrative behavior. In 1959, Malcolm, Roseboom, Clark & Fazar (1959, p. 680) diagram of a computer process that includes inputs, flows, outputs, and a variety of feedbacks. Holsti, Brody & North

[5] For many of the papers discussed, it is the diagrams themselves that establish the linkage to cybernetics or general systems theory. Citations are frequently very poor.

(1964, p. 175) provide an early Shannon diagram in international relations where the communication sender and receiver are two states in negotiation and the bidirectional nature of the process is represented as feedback.

In 1966, Fuchs (1966, p. 84) used a schematic that reflects some elements of black box flow charts in a paper on the health services economy. In 1968, Logan (1968, pp. 128, 130) uses a somewhat modified linear flow that divides inputs into “need” and resources. Need is a societal level measure of potential service units, such as the demand for health care. In 1969, Jelinek (1969, p. 53) uses a simple black box diagram to a patient care system. This diagram also divides demand for services from economic inputs, treating the latter as “inputs.” Demand is treated as similar to environmental factors in an open system. The process itself is opaque. In the same year and subsequently, Skandra (1969, pp. 58, 61; 1971, pp. 122-123) shows “cybernetic” schematics for business and industrial process control and computing. The introduction of “process control” in these schematics reflects a more sophisticated adoption of cybernetic concepts. The diagrams also include “quality control,” which is sometimes labeled “Servo-Mechanism”); this is another indication of growing sophistication in cybernetic reasoning.

In the 1970s there were similar or related diagrams and schematics by Yee, Shores, & Skuldt (1970, p. 82); Silverman, Brotman, Suffet and Ordes (1970, p. 256); Alkin (1970, pp. 15, 16); Moss (1970, p. 20); Miller & King (1971, p. 60); Massey & Cordey-Hayes (1971, p. 36); MacMurray (1971, p. 203); Mauch (1973, pp. 149, 159); Frank (1973, p. 531); Mascarenhas (1974, p. 42); Reeves (1974, p. 250); Greytak, Phares, & Morely (1976, p. 12); Turner (1976, pp. 9, 10); Pederson (1977, p. 6); Brown (1977, p. 19); Kaufman, Delange & Selfridge (1977, pp. 288, 291); Imboden (1978, p. 42); Trivedi (1978, p. 257); Adam (1979, p. 33); and Ostrom, Parks, Percy, & Whitaker (1979, pp. 5, 6, 8, 10). Most, but not all of these are linear models that reflect resources, processes and outputs. Often feedback is represented. The Frank (1973, p. 531) and Pederson (1977, p. 6) diagrams along with Negandhi (1975, p. 340) capture non-cybernetic constructs, but also include some cybernetic elements such as the common linearity or exposure to the environment (feedback, noise). Mauch (1973, pp. 149, 159) focuses on hierarchy rather than linearity, but his use of terms such as goals and objectives suggests the more recent linkage between outcomes and strategic planning. The Moss diagram, although very simple, ends in outcomes. In some others the outputs are associated with public purposes (goals, plans, objectives or other similar teleological terms), which is particularly common when the accompanying language includes the term “logical framework” (Brown, 1977; Imboden, 1978; Kaufman et al., 1977; Turner, 1976). Funnell & Rogers (2011, pp. 16-22) trace the development of “program theory” partly through this term back to Don Kirkpatrick’s work in the late 1950s.

Some of the models are of particular interest. Turner (1976, pp. 9, 10) connects a variety of variables to program purposes, but does so in a hierarchical or radial approach, rather than in the more typical linear model.

Greytak, Phares, & Morely (1976, p. 12) demonstrate an extended linear model of performance beginning at ‘revenue” and ending at societal “goal attainment.” The full set of elements is:

Revenue→Expenditures→Inputs→Outputs→Outcomes→Goal Attainment

While this model omits the explicit cybernetic component of feedback, although it may be implied with the revenue and expenditures at the beginning, and while it omits the central process node, it reflects a fairly broad conceptualization of performance in extending the end to outcomes and societal goals.

Kaufman, Delange & Selfridge (1977, pp. 288, 291) take a very extensive systems approach showing several decision loops and along a relatively linear path. These decision loops are internal process feedback steps.

Trivedi (1978, p. 257) demonstrates a three node cybernetic model with external feedback for a hospital. The three nodes are inputs, process, and output. The inputs are divided into factors of production (the most commonly mentioned inputs in current “logic models”) and patients. Processes are divided into four categories, treatment regimens, level of technology, quality level and efficiency. Of these, the current terminology for “treatment regimens” and “level of technology” would be “theory of change” or “program theory”; while “quality level” and “efficiency” continue to be used in approximately the same manner. Trivedi places three items in the output category: treated patients, teaching, and research. In this respect, the model focuses on a hospital as a multifunctional organizational, not simply a health care environment. Yet, current logic model language would certainly include treated patients as in some way related to hospital care, either the output or the bearer of the output. The Trivedi model has no individual outcome or sectorial impact components. Feedback is not represented in detail, but exposure to the environment is shown throughout the linear (input to output) process.

The Adam (1979, p. 33) model reflects a much more abstract conceptualization than the Trivedi schematic. As with Jelinek (1969, p. 53), Adam shows process as a simple empty box, labeled in this occurrence, “Public Technological Process.” In other diagrams that are less like common cybernetic diagrams, but similar to those by Frank (1973, p. 531), Adam (1979, pp. 30, 31) begins to demonstrate the application of “quality” beyond the process stage of the the cycle. Adam treats inputs as equivalent to economic inputs, which his text clarifies as factors of production expanded to include process design, which in the language of performance and evaluation would be “theory of change,” or “program theory.” In this respect, Adam has externalized the workings of the black box as an input.

Ostrom, Parks, Percy, & Whitaker (1979, pp. 5, 6, 8, 10) demonstrate a number of diagrams and tables that reflect the performance model within the cybernetic paradigm. The diagrams on pages 5 and 6 serve to extend the construct of performance from the typical pre-cybernetic model focused on output (and economic efficiency) (page 5) to more thorough model recognizing outcomes (page 6), which are classified as objective and subjective. These concepts are further expanded on page 10 with a table that had the headings: Inputs, Activities, Outputs, Objective Outcomes, and Subjective Outcomes. Ostrom *et al*., (1979), attribute their use of the extended cybernetic models to prior work, citing, in particular, Greytak, Phares, & Morely (1976). To a degree, the subjective outcomes begin to approach societal impact issues.

The Logic Model

Wholey’s text *Evaluation: Promise and Performance* (1979) introduced the term “program logic” along with other fairly new logics (“evaluation logic” and “evaluability assessment logic”). Between 1979 and the mid-1990s “program logic” transformed into the term “logic model” (H. Hatry et al., 1996). The 1979 program logic diagrams found throughout Wholey (1979) reflect Urban Institute studies from the mid-1970s. On page 23 there is a diagram reproduced from Horst (1974) reflecting the categories resources, program activities, process objectives and program objectives. These categories are similar to the Ostrom *et al*., (1979), categories. On page 28 the program logic extracted from Nay, Scanlon, Graham & Waller (1977) shows three substantial stages: inputs, process and outcomes. Here the inputs are clientele, not economic resources. Process and outcomes are shown in complex detail; there is no opaque black box. Outcomes are at the individual level, not at the societal level. The Wholey text contains numerous diagrams, which cannot individually be reviewed here. What is of interest is that the material reflects no break from the developments from the previous decades, it is a continuation of the same constructs.

Wholey's and the Urban Institute's main contribution is the much more detailed examination of the internal workings of the process, what is now "program theory" or "theory of change," within the structure of the systems diagram. For example, on page 38 the diagram shows numerous stages of "activities," not just one undifferentiated "process" as found with Jelinek, Adam, or many other precursors. This extensive development of program theory allows for association between logic modeling and (1) organizational design and management and (2) data modeling, data collection and managerial performance measurement and monitoring.[6]

What is generally missing from Wholey text is early cybernetic insights related to feedback. There is some implication of feedback because there is a modest recognition that evaluation or performance monitoring is a form of feedback. However, in general the program models developed throughout this period culminating in the early logic models are linear with little expectation of self-maintaining feedback processes either intentional or unintentional.

The current literature of logic models can be divided into literature instructing in the use of logic models (Comfort, 2010; Fawcett et al., 2001; Frechtling, 2007; Funnell & Rogers, 2011; H. Hatry et al., 1996; Hughes, 2010; Knowlton & Phillips, 2013; Kusek & Rist, 2004; McLaughlin & Jordan, 2004; Mertens & Wilson, 2012; C. C. Phillips, 2004; Phills, 2005;

[6] "Managerial performance measurement and monitoring," is used to refer to data collection and reporting that is functional for managerial purposes, not, primarily, external reporting purposes. The overall systems model, without the deep program theory, may be more relevant to external reporting.

Roberts, 2004; Rogers & Weiss, 2007; Wholey, 1979, 1983) and literature using logic models, some of which is also instructional (Baxter, 2011; Cutt & Murray, 2000; Davidson, 2010; Gould et al., 2011; Healey & Lesneski, 2011; Holtgrave, Harrison, Gerber, Aultman, & Scarlett, 1996; Leroy et al., 2005; Ludwig, Kling, & Mullainathan, 2011; Mancini, Huebner, McCollum, & Marek, 2005; Mancini & Marek, 2004; Murphy, 2011; Newcomer & Allen, 2010; Pestronk & Franks, 2003; T. Phillips, Bonney, & Shirk, 2012; Safrit, 2011; Satterfield et al., 2004; Sherman & Brothers, 2011; Smith, 2005; Vigdor & Mercy, 2003; Vredenburg & Westley, 2003; Wichowsky & Moynihan, 2008; World Bank, 2011; World Health Organization, 2002).

Of the instructional literature, the principle texts are Frechtling, Funnell & Rogers, and Knowlton & Phillips; however, many current articles, particularly those related to the nonprofit sector, refer to, or rely on, the Kellogg Foundation text (C. C. Phillips, 2004), which is a web publication that has gone through several updates. The most sophisticated of these texts is Funnell & Rogers in that it provides a better account of complex, compared with simple systems. It is, however, dominated by abstract guidance rather than showing concrete application. Like the others, it primarily addresses the evaluation community, failing to show strong linkages to management or performance measurement literature; although Frechtling (2007, p. 11) does assert that one use of logic modeling is “managing the project.” The Frechtling text exhibits the most focus on detailed linkages, which can translate into beneficial data modeling for measurement purposes. Funnel & Rogers also discuss detailed linkages somewhat. Both of these texts sometimes forfeit precise diagramming in favor of more aesthetically pleasing diagrams in some instances. Knowlton & Phillips draw a distinction between more abstract “theory of change” logic models and more detailed “program” logic models. Funnell & Rogers, appear to make a similar distinction referring to the more abstract models as “pipeline” models. With both of these texts, the more abstract models can have multiple entries (such as multiple inputs) within a single node. As the word pipeline implies, the abstract models are highly linear and, in fact, all the models are principally unidirectional. Feedback is recognized as external feedback, not distinguished from noise, by Frechtling and as iterative interaction with unspecified resource providers by Funnell & Rogers. Knowlton & Phillips (2013, 24% - no page number available) address the idea of nonlinear theory of change models; however, the diagrams they demonstrate do not clearly relate to other diagrams within the logic modeling framework. Knowlton & Phillips appear to allow the most deviation from any standard approach to modeling. Funnell & Rogers provide a compendium of similar terms on pages 27 through 31.

All, or at least most, of these models are unidirectional (linear) models that reflect some sophistication beyond the Wholey text. They may range from very small scale to national or international in scope, but, even with larger scope models, they tend to be made of relatively few elements.

The models in use frequently follow the pipeline design (Cutt & Murray, 2000, pp. 36-37; Gould et al., 2011, pp. 46, 84; Healey & Lesneski, 2011, p. 256; Ludwig et al., 2011, p. 19; Mancini et al., 2005, p. 276; Mancini & Marek, 2004, p. 339; Murphy, 2011, p. 72; T. Phillips et al., 2012, p. 87; Safrit, 2011, p. 395; Satterfield et al., 2004, p. 119; Vigdor & Mercy, 2003, p. 168; Wichowsky & Moynihan, 2008, p. 917; World Bank, 2011, p. 131). However, there are also a number of more sophisticated models (Davidson, 2010, p. 739; Leroy et al., 2005, p. 140; Smith, 2005, p. 196).   Some are hard to classify (Baxter, 2011, p. 70; Newcomer & Allen, 2010, pp. 216,217; Vredenburg & Westley, 2003, p. 87) because the various researchers vary sharply from standard uses of the diagram. A small number of logic models in use are empirical models using the terminology as a basis for developing path analyses (Deardorff, Pysarchik, & Yun, 2009; Y. D. Harrison, Kostic, Toton, & Zurek, 2010; Urban & Trochim, 2009). These implicitly require very clear linkages.

Discussion

The logic model is the current stage of the evolution of the cybernetic/systems model of performance. It reflects, to a certain degree, a merger between wider scope external reporting and narrower, more focused internal analysis. It also merges systems thinking with earlier more transactional, less process oriented, performance thinking. As a stage in this evolution, one can take a look at where things stand.

Systems thinking includes Shannon's development of message, encoding, transmission through channels (with noise), decoding and reception; Weiner's servo-mechanism (feedback); and the linear: Input → [Black Box] → Output. The linear process model combines with Shannon or Weiner with potentially different implications as the linkages may be channels or simply direction of influence between nodes.

Before integration with systems thinking, the performance paradigm was primarily transactional, that is, the conceptual model was inputs lead to a transaction resulting in outputs. The transaction is represented by a ratio normally called efficiency (Ridley & Simon, 1943).[7] Over the 1970s, performance transformed from transaction to process located at nodes. The linkages show direction of influence; particularly with pipeline models, where only a crude temporal/causal order is implied by the linkages, but is also so with other models where the nodes are meaningfully labeled, but the linkages are simply drawn and may even be combined for aesthetic purposes. This can lead to some confusion in the labeling of nodes as they may refer

[7] The efficiency construct of this earlier period includes some elements of effectiveness.

to actions or the products of actions (for example, producing a public service announcement or the public service announcement itself). This difficulty could be clarified if nodes referred to terminal points of processes, while linkages referred to the processes (the channels) themselves. Obviously this would lead to rather less aesthetically pleasing logic models.

Another confusion is that many actual logic models have difficulty fitting within the framework of input→process→output→outcome largely because they involve various levels of modeling program theories (or management processes) and the various scholars seem reluctant to (correctly) assign the overwhelming share of their models to process. Another difficulty with the standard pipeline is strict linearity from input to outcome. In actual programs, strict linearity is broken because different clientele are at different stages; but, more importantly, for long lasting programs (and it is not clear how long that might be), some outputs and even outcomes may occur while other processes are still in operation consuming more economic inputs.

Only rarely do models go to the last stage, societal impact, although sometimes for large scope pipeline models, this may be the intended meaning of outcomes. Smaller organizations are generally interested in what they do for their actual clientele and may find it difficult to understand that this must be put in the context of how social conditions improve.

The models only poorly handle noise and feedback and some may confuse the two. Noise is the random, and sometimes nonrandom, perturbations of the phenomena surrounding the program. It contains no useful information or information that is in no particular way special to the program, but it may, nevertheless, interfere with the success of the program. This may be the meaning of the “environment,” as represented in many of the models. However, the environment may also be the location of one of two important forms of feedback. External feedback can involve decision makers who control resources; sources for factors of production, who may respond to demand for their goods or services; or reserves of social goods or problem vectors. Program processes, outputs, or outcomes can activate any of these sources of feedback, and that may be an alternative meaning of the “environment,” as represented in these models. For these models to be more useful, it would be beneficial for them to draw a distinction between noise and external feedback, and develop devices for modeling external feedback.

Most of these systems can also have internal feedback – a student is returned to the same grade level to try again, a pre-audit of a decision finds defects requiring additional information, and so forth. While the Frechtling and possibly the Funnell & Rogers models have the capacity to model such internal feedback, it is not clear that this is a developed procedure. This oversight would appear to reflect the prioritization of evaluation over management or performance monitoring.

The textual material does not link these models with the critical performance concepts of efficiency, effectiveness, equity, quality, or satisfaction. And, the sometimes clarified distinction between economic inputs and process inputs (typically, clientele), is not reinforced. These are a clear losses. These concepts are well established in usage, although most require additional clarification as a result of conflicting definitions and a failure to clearly link their application to the various stages of the linear systems model of performance. Clarifying the relationship between these concepts and logic model would improve the usage for both.

Conclusion

This paper shows the development of the core performance or evaluation construct through the gradual adoption of the systems model. The paper shows that the logic model can be traced to other more rudimentary adoptions of systems models since the 1960s. It merges more clearly performance constructs such as inputs and outputs with more clearly evaluation constructs such as the more elaborate program theory, largely within an elaborate black box framework. The merger is only partly complete and may benefit form additional adoption of systems concepts.

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