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Systems Thinking: Opportunities and Challenges in the Graduate Classroom

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What do the following scenarios, drawn from actual firms, have in common?

Scenario 1. An automobile manufacturer implements a quality improvement program that successfully creates additional manufacturing capacity (Keating et al., 1999). To prevent downsizing that might discourage further improvement, management commits to increasing sales by developing new vehicles. To speed up existing design processes, the manager of the improvement program is assigned to oversee implementation of a similar program in R&D. Employees in R&D however are challenged by the need to both increase the number of new car designs and participate in improvement projects. As a result, the improvement program fails to catch on and there is no increase in the number of new models. Demand does not increase as anticipated, excess manufacturing capacity has to be trimmed, and the labor force is reduced. Manufacturing personnel become cynical and distrustful of management and the improvement program there dies.

Scenario 2. A check printing company offers first time buyers a special introductory price. In response to this successful effort to attract new customers, competitors adopt the practice, the result being that customers switch from one company to another whenever they need to place a new order.

Scenario 3. A car maker offers employee pricing to all customers buying vehicles in the new model year. In response, competitors follow suit, the net result being to advance the timing of sales of new cars and potentially compromising sales of the following year's model cars.

While each of these failures of strategy can be explained in a number of different ways, one is the failure of management to fully understand the complexity of the situation by taking a systemic approach to understanding and responding to it. For example, failure to understand the impact of the R&D improvement program on the rate of new product development, coupled with a single minded focus on new product offerings, led to behavior that might have been avoided had the potential implications of the program's implementation been considered. One need not look far to find other examples of firms that, despite large investments of time, money, and resources, fail to reap the rewards of large, strategic initiatives due to a failure to think systemically. Failed efforts at implementing downsizing and other cost cutting measures (e.g., cutting investment in R&D in response to a financial crisis with the result that future product development and growth is compromised), and managing constrained resources (e.g., over extending equipment at the expense of maintenance, leading to increased machine failure rates and lower quality/productivity), are not uncommon. These can also be attributed, at least in part, to a failure to fully appreciate the complexity of the problem, or take a systemic approach to problem solving. In this article, we identify what it means to think systemically, and present insights into how systems thinking is viewed in

the leading U.S. graduate schools of management. In addition, we address some of the challenges to making systems thinking a staple in graduate management education.

Analytic versus Systemic Thinking: A Paradigm Shift

Explanations for the failures of strategic initiatives often revolve around a specific event, for example, lack of top management support, inadequate training, or selecting the wrong project. They also include the failure to develop the infrastructure—people, measurement systems, culture—needed to align actions with goals. While valid, these factors do not fully explain why early successes are not sustained. Organizations routinely point to pockets of success from new initiatives even when they cannot sustain or expand them. As parts of an organization improve in isolation, they reach a point where they become so interdependent that improvements in one area cause problems in another (Gharajedaghi, 1999). Moreover, these trade-offs prevent further improvement and threaten the existence of the improvement program. Why then do managers continue to avoid developing long-term solutions that take a systemic approach? While this can certainly be attributed to short term financial pressures and the need to generate rapid results, it can also be explained by the way managers think.

Much of a manager's training and education is based on the analytic thinking paradigm (Ackoff, 1981), according to which thinking and analysis are synonymous. Analysis involves understanding a system by breaking it into smaller parts and studying them in isolation. Once the parts are understood, the behavior of the whole can be understood based on the behavior of the parts. Analytic thinking explains what the parts do and how they work. We are also conditioned from an early stage to develop an event-oriented view of the world (Sterman, 2000). *If I touch a hot stove I get burned, if I don't watch where I am walking I will stumble over.* In other words, we develop a linear view of cause and effect in which the 'cause' is followed *soon* thereafter by the 'effect,' leading us to assume, erroneously in many cases, causality. These factors contribute to our treating problems as simple, isolated events, solving them using a discrete, linear process; problem recognition, identification of alternatives, selection and implementation of solutions; problem resolution. While this may work with simple systems, it does not work within the complex social systems typical of today's business environment. We suggest that analysis alone may be insufficient to fully address issues of complexity inherent in contemporary business decision making.

A systems approach to understanding how the world works can be traced to the early Greeks, and has been utilized in a wide variety of disciplines ranging from philosophy to physics. Efforts to develop systems methodologies to address 'real world' problems began during World War II. Early attempts used mathematical models to identify optimal solutions to complex problems. The inability of initial techniques to accommodate non-quantitative issues such as motivation, beliefs, and values, as well as factors such as time delays and feedback loops, have however prompted the evolution of other systems methodologies. Ackoff (1981) differentiated between analytic thinking and synthetic (holistic) thinking. Synthetic thinking attempts to understand the larger context within which a system operates. Once the role of a system within this context is understood, the behavior of the system can be explained based on that role. Synthetic thinking focuses on why the parts do what they do relative to each other. Ackoff also observed that when a system is disassembled, the system and its parts lose their essential properties, yet observation of the interaction between and among the parts is crucial to understanding system behavior. This is reflected in changes in business school curricula that have emphasized the integration of material from different functional areas. Forrester (1971) identified additional characteristics of complex systems common to today's business environment. For example, cause and effect are often separated in time and space. Effective short term solutions often create larger long term problems, while actions that make things worse in the short term may have long-term positive effects. Decision makers often fail to learn from their mistakes, either because of the delay between one person making a decision and another experiencing its effect, or because the short-term result observed by the decision maker differs from the long-term outcome the decision maker does not see. Complex networks of non-linear feedback loops within systems also contribute to creating counterintuitive behavior. The 'law of unintended consequences' is a reflection of this phenomenon. Richmond (2000) defined two types of thinking related to the phenomena described by Forrester. Dynamic thinking focuses on the behavior of a system over time rather than in reaction to an isolated event. Closed-loop thinking focuses on the role the structure of the system (i.e., performance measures, reward systems, and information flows) has on behavior, and the role of interactions of the system with external forces. It thus provides an understanding of how interactions feedback to shape the end result of an intervention to the system.

While various authors have described individual elements of systems thinking and others have used the term 'systems thinking' or 'thinking systemically' to characterize a more 'holistic' approach to thinking and decision making, there has been no formal definition of systems thinking. We therefore propose the following managerial definition of systems thinking:

> *The ability to link decisions made over an extended period of time to subsequent resource (customers, suppliers, employees, etc.) behaviors, which in turn create systems performance outcomes.*

Systems thinking has its own set of tools and methodologies thus help is at hand to respond to the reality that effective decision making must incorpo-

rate not only analytic thinking, but also synthetic, dynamic, and closed loop thinking. For example, causal loop diagrams can be used to illustrate feedback structures within a system, and stock and flow diagrams can be used to characterize the movement and accumulation of entities of interest within a system at various points [for details of systems thinking methodologies and tools, readers are referred to Sterman (2002)]. Such tools allow one to understand flows and accumulations over time in response to decisions and reactions by internal and external forces, thereby developing a dynamic rather than static representation of a problem.

Our interest is in exploring how systems thinking fits into a graduate management education. Teaching students about systems is not the same as teaching students to think systemically. The human mind is incapable of fully understanding the behavior of complex social systems without the assistance of tools and technology (Forrester, 1971; Booth et al., 2000). As several scholars have suggested, businesses are complex social systems (Senge, 1990; Ackoff, 1994; Deming, 1994; Forrester, 1994). The relevant question this raises is where should business leaders acquire the training and tools needed to help them manage complex social systems? Graduate schools of management are one possible venue. MBA and similar programs are a staple element in the training of managers. They have undergone significant change and revision in recent years to among other things, help better prepare graduates to manage complexity. It is not clear however whether these changes have extended to including discussions of systems thinking. It is also not clear whether faculty believe there is a role for systems thinking in the curriculum or if they are even aware of what it is. We examine these issues. We do not intend to indict the prevailing wisdom on curriculum, pedagogy, or educational philosophy nor do we take the position of advocacy. Rather we suggest that systems thinking represents one possible approach to help students better address the challenges of complexity. We are also intimately aware of the realities of prevailing institutional structures, responsiveness (or otherwise) to change, and faculty autonomy. We do however believe that lively discussion can, at a minimum, create debate, awareness, and the stimulus to re-think existing paradigms.

Systems Thinking: Perceptions and Practice

Results of a survey of faculty at the fifty leading graduate management schools in the U.S. (differences in the five ranking schemes used meant that there are actually 63 schools in the top 50!) showed that more than 41 percent of respondents defined systems thinking synonymously with thinking about systems, making no reference to time delays, feedback, or interactions, or could not define it. (Five definitions, drawn from discussions with faculty and a review of textbooks in the various business disciplines, were offered. These included definitions incorporating none of the dimensions of time delays, interactions, feedback, and external forces and those that included one or more.) A further 19 percent equated it with synthetic thinking, making reference only to interactions. Only 40 percent defined systems thinking in a manner that reflects its multiple dimensions. One must be cautious in interpreting these results. It is possible that a respondent assumed the relevance of time delays, feedback, interactions, or external forces in defining systems thinking yet selected a definition that did not include one or more of these. However, the fact that they did so when a more comprehensive definition was available suggests a less than complete view of systems thinking. It also suggests that while the terms systems thinking and systemic thinking are commonly used, there is a lack of consistency in how they are being used and that they may be being used erroneously.

Seventy four percent of respondents indicated that systems thinking should be an essential part of a graduate business program. However, less than half of these respondents indicated it was being covered at their institution. Since many faculty do not appear to have a full grasp of what systems thinking is, it is thus not clear what exactly these respondents believe is an essential part of the curriculum, or what exactly is being taught. Conversely, the fact that the majority of faculty defined systems thinking synonymously with thinking about systems or synthetic thinking, yet relatively few that believe it is taught at their institution, raises the more intriguing question of what is being taught! Adding to the intrigue is that of those respondents that defined systems thinking in a complete manner, several did not feel it was an essential part of a graduate management education. While these numbers were relatively small, they raise the question of why faculty, let alone those at the leading graduate business schools, would question the need to educate students about concepts and tools that expressly address complex, dynamic, cross functional, multi-period problems. Taken together, the results raise several additional important questions. If faculty believe systems thinking is essential, why is it not being taught on a more widespread basis? If respondents do not believe it is essential, why not? In light of the earlier discussion on the complexity of social systems, it may appear inconceivable to some that discussion of feedback, interactions, and time delays, are not essential parts of graduate management education.

Moving Ahead . . . or Not!

If one takes the position that graduate management students aspire to become business leaders, and as such, they need to develop the capacity to address complex business problems, what do the results mean for educators? A starting point is the need to increase awareness within the academic community of what systems thinking is and how it can contribute to enhancing the educational process. How can this be accomplished? While several individuals have discussed systems thinking over

the years, no one has focused on the cognitive processes involved. Indeed, definitions are derived from narrow perspectives promoting specific views of systems thinking. It is our hope that our definition of systems thinking, embodying various dimensions and schools of thought, will be a first step in developing a unified understanding of the concept so that when the term systems thinking is used, it is clear what is being referred to and that it is being used to refer to the same thing.

Increased dissemination of academic materials on systems thinking would facilitate increasing awareness. Synthetic thinking is the most visible and readily recognized element of systems thinking. Materials discussing other elements are not however as widely disseminated (Repenning, 2003). There are several possible reasons for this. First, the publication process inherently favors research fitting a particular mold. We are all trained analysts (Ackoff, 1981). The result has been to create a silo mentality where research topics or methodologies that do not fit a particular silo can be dismissed based on lack of fit with the focus of a journal or questionable merit. This has several consequences. First, researchers are dissuaded from innovation and cutting across functional or methodological boundaries for fear of not being able to publish in 'mainstream' journals. Applying this logic to systems thinking, established business journals that could serve the role of broadening research agendas and introducing new ideas, do not accomplish these goals. Those working in a particular niche are thus motivated to develop new journals to fit a particular need. The "Catch 22" however is who will be motivated to publish in these journals; those whose work fits this particular niche. New journals are thus created that focus on, for example, systems thinking, that are out of necessity just as guilty of being insular and having a narrowly defined audience (Repenning, 2003). A related issue is the prevailing bias towards correlation-based research. This makes us suspicious of research seeking to establish causation, the focus of much of the systems thinking research. Unlike much of the more traditional research, particularly in the decision sciences, systems thinking research often incorporates 'soft' variables such as attitudes and beliefs, the motivation behind behavior being critical to understanding complex systems. Such variables are not easy to quantify and measure and are thus often excluded in traditional business research. This again places limits on the willingness of mainstream journals to publish work on systems thinking.

These perils of the publication process have secondary consequences for promotion and tenure decisions and for curriculum development at research institutions. If faculty are concerned that work published in emerging fields will not be valued, either because the journals are not established or the fields are not understood or accepted by senior faculty on promotion committees, they will hesitate before continuing to work in these fields. Similarly, doctoral programs will hesitate to expand coverage of these fields for fear that students will not be able to publish let alone gain meaningful academic appointments. The result is to squeeze the pool of faculty members that could play a role in increasing awareness of these fields, such as systems thinking. Moreover, it contributes to the creation of a niche of 'believer' faculty and schools that stay primarily within themselves (Repenning 2003), further inhibiting broad dissemination of new ideas.

The biases described above have been previously recognized and criticized by other researchers, so this is not a unique call for a mind shift. It has long been recognized that the silo mentality often found in business is dysfunctional and that the functional areas of a business are interdependent rather than independent (Gharajedaghi, 1999). Christensen and Raynor (2003) pointed out the need for greater acceptance of causation based research due to its necessity in developing good management theories. Ghoshal (2005) and Bennis and O'Toole (2005) also called for business researchers to incorporate human intentionality into their projects.

How does one explain that a segment of faculty do not believe systems thinking is an essential part of a graduate management education? Among faculty that have a broad understanding of systems thinking, it may be that some believe that it cannot be taught, that students should receive this training elsewhere in their academic careers, or that knowledge and competence should be acquired from on job experience. Some may believe there are more pressing needs in the curriculum. It may also be a reflection of the implications bringing systems thinking into the curriculum would have for them for them personally. Among faculty that defined systems thinking synonymously with synthetic thinking or thinking about systems, it is harder still to come up with an explanation. How does one even speculate as to why understanding the nature of a system and interactions between variables are not essential elements of a graduate management education?

It is easier to identify possible reasons why systems thinking, or as the case may be, synthetic thinking, is not more widely taught. One cannot teach what one does not know, pertinent here given the more than 65 percent of faculty who did not select the most complete definition of systems thinking. The lack of appropriate incentives, both in compensation and promotion and tenure decisions, the challenge of adding new content without expanding the number of courses in the curriculum, the fear of losing one's control over the curriculum if new courses are added, the belief that incorporating new content is someone else's responsibility, and the lack of faculty able or willing to incorporate the new content into existing classes, all represent additional hurdles to curriculum change, not only in the context of systems thinking, but more generally.

The news is not, however, all bad! As the survey results suggest, there is

recognition of the importance of systems thinking in graduate management education as well as of current inadequacies in its coverage. In addition, a variety of materials is available to support those interested in incorporating systems thinking into their courses. Several of these are discussed in a recent article in the *Decision Sciences Journal of Innovative Education* along with tips and examples of how they might be used (Atwater & Pittman, 2006). One of the challenges in teaching systems thinking is the need to create a dynamic, multi-period setting in which the impact of decisions made can be observed. Traditional cases do not lend themselves to this as they are, out of necessity, static in nature. There are however several simulation games that can be used to teach systems thinking. Probably the best known is 'The Beer Game,' which is widely used to teach supply chain management concepts. There are also several computer simulations. For example, in 'People's Express,' students must make decisions about capital equipment expenditures, marketing, and human resources, while in 'B&B Enterprises,' participants go through the experience of introducing a new product, encountering the boom and bust cycle that is common in this situation. Several websites also offer systems thinking material that can be used to teach a wide range of issues. For example, Pegasus.com offers a variety of materials for teaching systems thinking, and Strategydynamics.com offers materials related to teaching systems thinking in the context of business strategy. Ventana Systems (Vensim.com) offers a free version of their simulation software that can be used for educational purposes.

Concluding Remarks

As the business environment continues to evolve, so must the approaches used to prepare individuals to manage in this new world. There are multiple approaches, philosophies, and pedagogical styles that can be adopted to help prepare the next generation of business leader. Our intent is not to put one atop the others but to raise awareness of one approach that would appear to fit well with the increasing challenges of complexity that managers today face. The analytic paradigm has served us well for over four hundred years (Ackoff, 1981). The question now is whether there are alternative tool sets that can be used in conjunction with the tools of analysis as part of the manager's arsenal in managing complexity. Analytically based improvement efforts have removed all the slack from the system so that further efforts guided solely by this methodology generate the problems highlighted at the beginning of this paper (Gharajedaghi, 1999). Consequently, it appears that the time is right to start using and developing systems thinking tools. The challenges this poses to business educators are to better understand what it means to think systemically, to critically examine whether training students in the principles of systems thinking is the responsibility of graduate management programs, and if so, determining how exactly this can be accomplished. Despite MBA curricula having undergone considerable change in the last decade, they remain subject to criticism (Ghoshal, 2005; Bennis and O'Toole, 2005). Much of this revolves around curricula being too functionally focused, not adequately examining issues of complexity, and not being aligned closely enough with the 'real world.' Perhaps incorporating systems thinking into the curriculum and helping prepare graduates to better appreciate and respond to complexity is one way to silence at least some of the critics.

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