

Communication

Practical Applications of Systems Thinking to Business

Jamie Monat ^{*ID}, Matthew Amisshah and Thomas Gannon

Electrical & Computer Engineering Department (Systems Engineering Program), Worcester Polytechnic Institute, Worcester, MA 01609, USA; mamissah@wpi.edu (M.A.); tgannon@wpi.edu (T.G.)

* Correspondence: jmonat@wpi.edu

Received: 29 March 2020; Accepted: 29 April 2020; Published: 2 May 2020



Abstract: In this paper we summarize the research on Systems Thinking for business management and explore several examples of business failures due to a lack of application of Systems Thinking, with an ultimate goal of offering a Systems Thinking approach that is useful to all levels of management. Although there is significant literature aimed at facilitating Systems Thinking in organizational management, there remains a lack of adoption of Systems Thinking in mainstream business practice. This is perhaps because the literature does not reduce high-level Systems Thinking principles to hands-on, practical protocols that are accessible for typical managers, thus limiting the working application of Systems Thinking concepts to researchers and consultants who specialize in the field. The goal of this work is to not only elaborate on the high-level ideals of System Thinking, but also to articulate a more precise and practical hands-on approach that is useful to all levels of business managers.

Keywords: systems thinking; business; complexity

1. Introduction

Systems Thinking has been characterized as a perspective, a language, and a set of tools that can be useful in solving complex problems that are typically not amenable to conventional reductionist thinking. Applications have been proposed in engineering, politics, international relations, biology, astrophysics, economics, etc. In this paper, we focus on the application of Systems Thinking to business. We summarize the research on Systems Thinking for organizational management, explore several examples of business failures due to a lack of application of Systems Thinking principles, and conclude with a practical, hands-on protocol that facilitates the application of Systems Thinking to business decisions. In light of the increasingly complex climate within which business managers operate, this paper highlights the need for and benefits of a practical discipline of Systems Thinking in business.

There is a significant body of literature (spanning a century of research) aimed at facilitating Systems Thinking in organizational management, yet there remains a lack of adoption of these approaches in mainstream business practice. We believe that this is because the high-level principles of Systems Thinking in organizations have not been reduced to hands-on rules and policies that are actionable by business managers. Although concepts such as the application of cybernetics to organizational viability, the benefits of dynamic modelling to understand systemic structure, the importance of shareholder participation in decision-making, and the importance of a holistic perspective are certainly valid, business managers need to know how Systems Thinking informs pricing decisions, product development, staffing decisions, sales commission structures, inventory management, quality assurance procedures, administrative decisions, and employee motivation. The goal of this work is to not only elaborate on the high-level ideals of System Thinking that offer a useful bird's eye perspective, but also to articulate a practical approach that is useful to all levels of business managers.

We adopt an inductive approach to the subject. Whereas the more common deductive approach would start with a theoretical framework for business and then develop and test a hypothesis such as “the application of Systems Thinking principles results in better business success”, we do not believe that we can make a convincing case using this reasoning. Instead, we start with business observations and then, using a Systems Thinking lens, work backwards toward generalizations and principles that are useful for business practitioners.

Following this inductive approach, we first identify specific failure or problem examples organized based on principal areas common to many businesses, namely: 1. product development and product lifecycle management, 2. sales and sales management, 3. pricing, 4. operations and quality assurance, and 5. administration. Where possible, we use famous examples that have been widely publicized. Where we cannot find famous examples, we tap our personal observations covering over 70 combined years of industrial business management experience and identify real examples from our own experience. We conclude each example with a discussion of Systems Thinking lessons that could have been implemented to avert the failure. Following the examples, we identify commonalities and ultimately synthesize these into a protocol that can be readily applied by decision-makers in similar contexts.

Although the approach adopted is mostly informal, it offers the benefit of effectively communicating lessons in Systems Thinking using well known business failures. The goal is to elevate Systems Thinking concepts to the level of a business management *paradigm* for the practitioner. This, we hope, shall offer managers a protocol for business that exploits the benefits of Systems Thinking, minimizes common errors, and maximizes profits.

Subsequent sections of the paper are organized as follows: Section 2 offers definitions and a review of Systems Thinking concepts. Section 3 entails a brief discussion of the literature on Systems Thinking in the context of organizations. Section 4 discusses examples of business failures that could have been averted with Systems Thinking. Section 5 discusses a practical, hands-on approach to implementing Systems Thinking in business management. In Section 6 we offer a summary of the paper and comment on expected contributions.

2. What is Systems Thinking?

Systems Thinking (ST) is a perspective, a language, and a set of tools [1]. It is a holistic perspective that acknowledges that the relationships among system components and between the components and the environment are as important (in terms of system behavior) as the components themselves. It is a language of feedback loops, emergent properties, complexity, hierarchies, self-organization, dynamics, and unintended consequences. Systems Thinking tools include the Iceberg Model [2,3], which posits that in human-designed systems, repeated events and patterns (which are observable) are caused by systemic structures (stocks, flows, and feedback loops) which are, in turn, caused by underlying mental models, which are often hidden. Examples of systemic structures include organizational hierarchy; social hierarchy; interrelationships; rules and procedures; authorities and approval levels; process flows and routes; incentives, compensation, goals, and metrics; and corporate culture. Behaviors are derived from these structures, which are (in turn) established due to mental models. A related fundamental Systems Thinking concept is that different people in the same structure will produce similar results. In order to understand behaviors, one must first identify and then understand the systemic structures and underlying mental models that cause them. The Iceberg Model is illustrated in Figure 1.

Additional Systems Thinking tools include causal loop diagrams, behavior-over-time plots, stock-and-flow diagrams, systemic root cause analysis (which often leads to culture as a systemic root cause), dynamic modeling tools, and archetypes. A more comprehensive explanation of Systems Thinking is provided by [1].

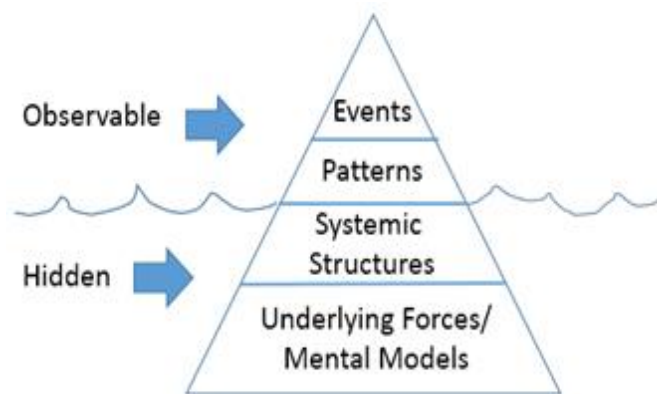


Figure 1. The Iceberg Model [1].

According to Monat [4], a system is a group of interacting, interrelated, or interdependent parts that together form a unified whole, for which the arrangement of the parts is significant, that has constraints and boundaries, and that attempts to maintain stability through feedback. Clearly, a business is a system. Yet, few people acknowledge this or use Systems Thinking to manage their businesses.

Inasmuch as businesses are rife with feedback loops, unintended consequences of business decisions, mental models and concomitant structures, and oscillations of inventory and staff levels, they are well-suited to Systems Thinking tools and concepts. Systems Thinking offers a lens for establishing and examining purpose, structure, and behavior in the context of an increasingly complex dynamic environment. In the following two sections we briefly review the literature and discuss some common business failures that occur as a result of poor Systems Thinking.

3. Literature Review

There is a significant body of research on the application of Systems Thinking in the context of managing business organizations. For the purpose of this work we offer an exploratory review that covers the main research paradigms and notable methodologies proposed in the literature. An outline of the literature is given here from the perspective of three research paradigms adapted from the work of Checkland [5] and Jackson [6], namely: Hard Systems Thinking (HST), Soft Systems Thinking (SST), and Critical Systems Thinking (CST). It is important to note that these paradigms are employed here to offer a cursory retrospection of the evolution of Systems Thinking (from 1930–1960s, 1970s, and 1980s, respectively) and are not intended to delineate hard categories applicable to all of the research literature.

The underlying assumption in HST is that human organizations can be objectively studied, modeled, and controlled to meet defined purposes. Thus, HST approaches are mainly driven by the development of models to understand organizations and inform on optimal courses of action to achieve end goals. Checkland [7] alluded to limitations in the treatment of ill-structured problems using HST approaches then espoused in disciplines such as Cybernetics, General Systems Theory, Systems Engineering, and Operations Research. An example HST approach is Viable Systems Diagnosis based on Stafford Beer's work in Management Cybernetics [8–10]. Beer's work sought to explain how systems are capable of maintaining their independent existence [11]. His Viable System Model (VSM) applies Cybernetics principles to specify, essentially, the pre-conditions of organizational viability. The VSM has been applied extensively as a tool for diagnosis and design of various business organizations. A review of the VSM and several case studies applying the model to organizational problems is given in [12,13].

Another HST approach initially developed in the late 1950s is Systems Dynamics. Jay Forrester's seminal work [14] extended the mathematics of feedback control systems to support simulation-based analysis for managerial decision-making. Later works in [15] and [16] extended the approach from the corporate world to modeling a broader context of social systems in order to inform urban and global policy decisions. Systems Dynamic models have been applied to various business contexts.

A classic example is the Beer Game [17], which, along with several others [18], is commonly used as a training tool demonstrating that business performance is often dictated by an underlying structure as opposed to random external factors or events that are out of the control of decision-makers. A compilation of case studies applying System Dynamic models to real world problems is offered by the System Dynamics Society [19]. Other HST approaches include applications of Complexity Theory to business [20,21], Agent-Based Modeling, and Simulation [22]. See Table 1 for a summary list of references for HST approaches.

SST, largely based on the work of Checkland, entails the fundamental assumption that managerial problems are typically ill-structured with several possible interpretations based on the perspective taken by an observer. SST thus emphasizes that the process of inquiry into such problem situations should be organized as a learning system that integrates divergent stakeholder perspectives. An example SST approach is Checkland's Soft Systems Methodology (SSM) [23]. It proposes an iterative process that develops and applies models under various stakeholder viewpoints to facilitate learning about a problem context in order to support decision-making. A more expansive review including case studies is provided in [24,25]. We identify other Systems Thinking methodologies that emphasize stakeholder participation and facilitating shared agreement of the problem situation under the SST paradigm. Examples include Interactive Planning [26] and Team Syntegrity [27]. The complete list of approaches identified is summarized in Table 1.

Finally, CST, embodied by the work of Jackson and Flood [6,28], argues for embracing multiple ST methodologies and selectively applying them based on the problem context. CST advocates assessing the problem situation and identifying inherent viewpoints, assumptions, biases, etc., while also understanding the available methodologies, their strengths, weaknesses, and implications for adoption. The Total Systems Intervention (TSI) methodology presents an approach for CST practice. It entails iterative phases: Creativity, Choice, and Implementation for problem characterization, selection of applicable methodologies, and implementation, respectively. An extensive review of TSI with example case study applications is offered in [29]. Table 1 presents an overview of the Systems Thinking paradigms discussed and examples of methodologies aligned with them.

Table 1. Overview of Business-related Systems Thinking Paradigms.

Paradigm	Description	Methodologies
Hard Systems Thinking	Systems Thinking (ST) essentially applies various models to understand and ultimately control the structure and consequent behavioral patterns constituting an identified problem situation	General Systems Theory [30,31] Viable System Diagnosis [8–10] Systems Dynamics [15,16,32] Enterprise Systems Engineering [33] Complexity Theory [20,21] Agent-Based Modeling and Simulation [22]
Soft Systems Thinking	ST essentially captures stakeholders' viewpoints, facilitates dialogue, learning and plans for implementing interventions in a problem situation.	Soft Systems Methodology [23] Interactive Planning [26] Social Systems Design [34,35] Strategic Assumption Surfacing and Testing [36] Team Syntegrity [27] Cognitive Mapping [37] Hypergame Analysis [38]
Critical Systems Thinking	ST entails critically evaluating a problem situation, divergent stakeholder worldviews of the situation while also assessing the strengths and weaknesses of candidate methodologies suitable for the problem context	Total Systems Intervention [29] Critical Heuristics [39]

As expected, more recent works in the field are integrative, supporting more than one paradigm. These are not only aimed at making recommendations for business decisions using models, but also exposing and shaping the mental models of stakeholders and guiding the overall problem-solving process

in organizations. A classic example is Peter Senge's *The Fifth Discipline* [40], which arguably sparked a resurgence in attention and adoption of Systems Thinking-motivated practices in business organizations. Senge defines Systems Thinking as a discipline for seeing wholes, a framework for seeing interrelationships rather than things, and for seeing patterns of change rather than snapshots. The perspective of Systems Thinking taken in the book is mostly based on System Dynamics, however it is not presented as a stand-alone approach. Systems Thinking is presented as a key discipline that integrates four others: Personal Mastery, Mental models, Building Shared Vision, and Team Learning. Senge identifies these disciplines as necessary for a learning organization.

A follow up book, *The Fifth Discipline Fieldbook* [2], offers a much more applied exploration of ST in business. It presents many practical examples and case studies, along with a problem-solving methodology. Similarly, Ballé [41] aimed at a practical guide to Systems Thinking in business, rooted in Systems Dynamics and Senge's work. He observed that a typical management reaction to an issue is a myopic, short-term solution instead of a long-term systemic analysis. This usually results in a pattern of recurrent problems that are supposed to have been solved in the past. Systems Thinking is proposed as the key to intuitive and sustainable solutions for addressing everyday business problems.

It is only proper that we end this review with a reference to Norman's article [42] on Systems Thinking in product development. The article proposes that products should be thought of as not just the physical entity, but rather as a service that encompasses the experience of researching, shopping, buying, using, and maintaining the product. Several products are given as examples to reinforce this idea: the Mini-Cooper, Amazon's Kindle, the iPod, etc. For example, he attributes the iPod's success not only to the physical device's aesthetics and functionality, but also to the music downloading service, digital rights management system, Apple's Genius Bar, etc., all of which combine to provide an excellent user service experience.

While the literature shows a sustained research effort spanning a century of methodologies and applications to enhance Systems Thinking, the adoption of these methodologies in the mainstream of business practice is lacking. In the subsequent sections we review several examples of major business failures which could have been avoided with Systems Thinking. This highlights the challenge of readily accessible Systems Thinking constructs that can be implemented as a guidance protocol to support the day-to-day decision-making involved in running a business.

4. Business and Business Component Failures and Systems Thinking Lessons

In this section we discuss several business failures, most of which are widely known, either because they have been well publicized in the media or are fairly common scenarios in business. The examples provided are drawn from the following principal areas: product development and product lifecycle management, sales and sales management, pricing, operations and quality assurance, and administration.

Each example concludes with a discussion of Systems Thinking lessons that could have been implemented as a strategy to avoid the failure. We must point out that the identified Systems Thinking lessons are not meant to imply that these problems have a simple or unique cause or fix. Rather, these observations underlie the broader theme that problems are often caused and/or reinforced by underlying organizational structures and the mental models of stakeholders involved. Therefore, decision-makers' responses to such problems should be informed by this broader perspective.

4.1. Examples in Product Development and Product Lifecycle Management

4.1.1. The Microsoft Zune

Apple released its spectacularly successful iPod in 2001. By 2005, sales exceeded 20 million units per year. To compete with Apple, Microsoft released its Zune personal music player in 2006 (shown in Figure 2). However, the Zune did not share the iPod's ergonomics or aesthetics. Moreover, Microsoft had not developed all the ancillary systemic structures that made the iPod successful.



Figure 2. Apple’s iPod and Microsoft’s Zune.

For the iPod to really catch on, a system had to be developed that facilitated the downloading of music from the Internet. This required not only the technology, but also consideration of ancillary factors, such as licensing, royalties, payment and transaction management, and storage. By addressing each of these with the development of iTunes, Apple not only enabled the iPod, but completely disrupted existing music listening technology (CDs).

Why is this Systems Thinking? In *Designing for People*, Don Norman says, “It is not about the iPod; it is about the system. Apple was the first company to license music for downloading. It provides a simple, easy to understand pricing scheme. It has a first-class website that is not only easy to use but fun as well. The purchase, downloading the song to the computer and thence to the iPod are all handled well and effortlessly. And the iPod is indeed well designed, well thought out, a pleasure to look at, to touch and hold, and to use. There are other excellent music players. No one seems to understand the systems thinking that has made Apple so successful.” [42].

The iPod is not a stand-alone product; instead, it is part of a personal entertainment system, the elements of which include the iPod itself, the individual who is listening, the environment (indoors, outdoors, office, gym, etc.), the songs, the song acquisition and storage, and the activities while listening (whether jogging, studying, relaxing, spinning, driving, etc.). The iPod Personal Entertainment System is not a product at all; it is a service. It is experienced, not consumed. Apple’s recognition of this and that the device itself is simply an element of this service was not only innovative, but revolutionary. While other manufacturers (Sony, Tascam, Microsoft, Diamond, etc.) structured their companies to support the device that they manufactured, Apple structured their company to support the user.

Systems Thinking Lesson: Failure to understand that many products are not really stand-alone devices, but instead are merely one component of a user experience system.

4.1.2. Polaroid

Polaroid rose to market dominance in instant photography as a result of the innovative products developed by its founder, Edwin Land, and was once considered a stellar example of a high-tech success [43]. In the 1980s, Polaroid was well aware of the emerging trend in electronic imaging technology, and by 1989 was spending 42% of its research and development budget on digital imaging. Polaroid was the number one provider of digital cameras by 1990.

Despite its early lead in the digital camera market, Polaroid failed to take full advantage of the emerging trends in digital photography, such as purely digital workflow. Senior management continued to rely on an outdated mental model that customers wanted hard-copy print, rather than electronic images that could be viewed on digital displays and in slide shows. Even though Polaroid made significant investments in its Micro-Electronics Laboratory in the mid-1980s, the company had a bias against electronics. That bias was fueled by the significant profitability of their film business with gross margins of over 65%, which made the consideration of new business models and markets out of the question (a frozen paradigm). Over time, customers began to realize the speed and cost-savings associated with digital workflow, as digital cameras became commodities and resolution increased. As a result, Polaroid began losing its largest customers in the real estate and photo-identification

markets, and its sales of film dropped precipitously. By October 2001, Polaroid filed for bankruptcy and never recovered.

Systems Thinking Lesson: This is an example of a flawed mental model. Although Polaroid instructed its researchers to develop digital cameras in response to emerging trends in digital photography, the focus was on developing digital cameras that could produce hard-copy print, without recognizing emerging new market opportunities. Polaroid's innovation was limited by its out-of-date mental models/frozen paradigm, while competitors such as Canon, Nikon, and even Kodak (to a degree) were better Systems Thinkers.

4.1.3. Research in Motion's Blackberry

The Blackberry smart phone (see Figure 3) was launched by Canadian company Research in Motion (RIM) in 1999 [44].



Figure 3. The Blackberry.

RIM had the lion's share of the smartphone market by 2007, with over 10 million subscribers, and was worth over \$67 Billion. The success of the Blackberry smart phone was due to several innovative features, such as the Blackberry Messenger (BBM) service and Blackberry Curve, strong security, and an embedded QWERTY physical keyboard. Blackberry was the device of choice by the government, many universities, and most businesses that required high security and inexpensive messaging.

However, in the late 2000s, Apple and Samsung began to out-innovate RIM. Apple created new ways for customers to use smartphones, such as an intuitive user interface and touchscreen navigation. Apple also developed means by which smartphones could make people's lives more convenient and more fun, and Samsung quickly followed suit. Apple saw the smartphone as more than just a communications device; they saw it as a component of a user experience system. Meanwhile, RIM did little to bring new features to its customers and failed to recognize the dynamic changes occurring in the business market.

Despite widespread consumer demand for hardware improvements (such as a touchscreen keypad, higher resolution, bigger screen, and faster Central Processing Units) and more applications (games, music, social media, interactive video, camera, and other entertainment), RIM focused instead on secure corporate communications. Well behind the competition, RIM finally launched a touchscreen device that was viewed as an inadequate imitation of the iPhone. By September 2013, the company announced a loss of almost \$1 billion due to unsold inventory. Today RIM is a shadow of its former self, with capitalization of less than \$4 billion (versus \$82 billion in 2008) and a stock price down more than 90% from its high of \$137.41 in mid-2008.

Systems Thinking Lesson: This is an unfortunate example of viewing products and services as stand-alone items and failing to recognize that most products are components of user experience systems. Blackberry continued to view its products as mobile e-mail devices, while Apple and Samsung created new ways to use smartphones as mobile entertainment devices, while continuing to provide e-mail services with an intuitive user interface.

4.1.4. Swiss Watchmakers

In the 1960s, the Swiss dominated the watchmaking industry, with over 60,000 employees and 65% of world-wide watch sales [45]. In those days, watches were analog devices with hands that were powered by windup mainsprings. In 1968, several Swiss researchers invented a new kind of quartz movement watch with no mainspring, powered by a tiny battery.

The Swiss watchmaking industry ignored this development in the belief that traditional watches would prevail forever—they did not even bother to patent the idea. In late 1968, the new quartz movement watch was displayed at the World Watch Congress. Seiko Japan saw the new product and immediately recognized its potential. They quickly began production of the new watches and started taking market share. By 1978 there were only 10,000 Swiss watchmakers and the Swiss had less than 10% of the watchmaking market. The industry was shaken again in 2015 with the introduction of Apple's smart watch, essentially a wrist-mounted computer that also happens to tell time. Stagnant mental models can ruin not only businesses but entire industries.

Systems Thinking Lesson: Failure to embrace a new mental model, or paradigm shift. Disruptive paradigm shifts, or changes in mental models, are common in business. Automobiles replacing horse-drawn carriages, the Internet displacing the library, CDs displacing vinyl records (and being displaced by online music), VHS tape being displaced first by DVDs and then by streaming movies, and personal smart phones displacing land lines are just a few examples.

4.2. Examples in Sales and Sales Management

4.2.1. Missed Sales Targets for the Introduction of New Products

Successful companies continuously introduce new products. However, sales targets for those products are often missed. Here is a typical scenario: Kate is a fantastic salesperson for the fictional Gooseberry Corp, which makes and sells smart phones, tablets, and laptops. She is top-notch and has exceeded her quota for each of the past four years. The company has just developed a new product, the "3D Tablet", which is more complicated, more expensive, and harder to sell than Gooseberry's other products. Kate's boss Rick wants Kate to push the new 3D tablet aggressively. Kate does not want to, arguing that this will reduce her sales of other products, decrease net revenue, and decrease her personal income. The situation has degenerated and Kate now thinks that Rick is obstinate and unreasonable. Rick thinks that Kate is insubordinate.

Kate is right to object; selling the unproven new product in lieu of the old will likely reduce her sales volume and hence her compensation. Removing Kate from her excellent performance selling established products to sell a new, unproven, complicated product is unwise. Instead, the company might consider hiring new, hungry salespeople or moving existing staff within sales or engineering to push the new product. This would provide sales growth without cannibalizing existing sales or compromising Kate's pay.

Systems Thinking Lesson: The sub-optimal structure of both the system for introducing new products and the compensation for selling them.

4.2.2. Sales Management

When a salesperson misses targets repeatedly, a good sales manager will analyze the salesperson's behavior and activities. In one such case, a sales manager observed declining sales for one of his salespeople. The manager also observed that the salesperson spent 70% of her time in the office, doing paperwork, scheduling appointments, etc. The manager sat with the salesperson and instructed her to get out of the office and visit customers and prospects at least 70% of the time. Over the following year, the salesperson was on the road 75% of the time, yet her sales did not increase. This is a classic Systems Thinking archetype called "seeking the wrong goal". Spending a lot of time with existing customers and unqualified prospects is not necessarily a good way to increase sales. Both prospects

and existing customers should be qualified to determine if products would be beneficial, before asking salespeople to call on them.

Systems Thinking Lesson: If the company had already been presenting the salesperson with qualified leads, then this indicates either a defective Goals-Behaviors-Metrics-Rewards (GBMR) system (an incorrect desired behavior was established) or an unqualified or untrained salesperson. If the company had not been developing qualified leads, then an incorrect business structure existed.

4.2.3. The Sales Commission Structure

In many companies, salespeople are rewarded based on a regressive commission structure. The more they sell, the smaller percentage they receive. For example, a sale of \$10,000 yields a commission paid of \$1,000 while a sale of \$100,000 yields a commission of \$2,000. The result is a lot of low dollar-volume sales, low efficiency, and reduced profit. This very common structure is based on a mental model geared towards limiting salespeople's compensation, which is counterproductive. A progressive structure that pays salespeople a higher percentage of large-dollar sales might indeed enrich the salespeople, but would also enrich the company.

Similarly, in many companies, sales are paid commissions based on sales dollars, instead of on profit dollars. In response, sales people often reduce product price to increase sales volume. In response to this, the company imposes limits on the discounts that sales are permitted to offer, or hides the factory costs from the salespeople, or requires multiple approvals for each sale. This structure hamstring the organization. A better approach would be to provide the salespeople full information on factory costs but reward them based on profit, not sales.

Systems Thinking Lesson: Poor structure deriving from poor mental models.

4.3. Examples in Pricing

4.3.1. Bank of America's 2011 Decision to Charge \$5 for Each Bank Card Transaction

In 2011, Bank of America instituted a charge of \$5 each time a debit card was used to make a purchase. They figured that this would increase profits dramatically while negligibly impacting customers. They were wrong: customers objected violently and staged mass protests, such as "Occupy Wall Street" and "Occupy Boston" [46]. Bank of America quickly changed its position and eliminated the fee. This was a clear example of a company badly misjudging consumers' reactions to a new policy.

Systems Thinking Lesson: Unintended consequences of a business decision.

4.3.2. Airlines' Decision to Charge for Checked Baggage

Starting in 2008, major U.S. airlines began charging customers for checked baggage. In reaction, passengers packed more and more into carry-on bags, filling overhead racks to bursting, thus creating a double inconvenience for travelers. This unintended consequence certainly contributes to consumers' hatred of the airline industry (according to Sheiresa Ngo of CheatSheet.com [47], airlines are the eighth most hated industry in the U.S.)

Systems Thinking Lesson: Unintended consequences of a business decision.

4.3.3. The National Parks Service Decision to Increase Entry Fees

In 1998, the National Park Service was suffering a shortfall in covering operating expenses. They decided that a simple solution would be to raise entry fees, evidently not realizing that park attendance volume is a function of the entry fee (a balancing feedback loop). As a result, attendance dropped and the shortfall increased. (Note that this error was almost repeated by the Trump administration in 2018, but rejected at the last minute due to public outrage.) Assuming that purchase volume is insensitive to price is a classic linear thinking business error.

Systems Thinking Lesson: Unintended consequences of a business decision.

4.3.4. The Market Manager's Decision to Increase Product Prices by 25%

In a New England separations company in the 1990s, a market manager was responsible for setting prices for filtration products. At one review meeting, the company owner chided the manager for not having raised prices over the last five years. The market manager's reaction was to make up for those five years in one fell swoop by raising prices by 25%. He believed that customers would be grateful upon realizing that they had been enjoying a fixed price over the past five years, while the cost of living had increased 25%. This proved false. Customers deserted the company and sales volume fell precipitously. A systemic feedback loop shows that customers stop being customers when they feel they are being abused.

Systems Thinking Lesson: Unintended consequences of a business decision.

4.4. Examples in Operations and Quality Assurance

4.4.1. Poor Inventory Management (The Beer Game)

In many companies, inventory levels oscillate instead of remaining stable, negatively affecting carrying costs, stock-outs, and profitability. Similar large oscillations often appear in staffing levels, factory loading, and Research & Development project backlog. Common management practice is to blame the individuals involved for allowing such swings. However, it is typically inherent systemic delays that cause the oscillations; the individuals involved have little control or influence. The Beer Game [17] is a famous system dynamics model depicting how systemic structure and feedback loops with delays yield oscillation in systems. In the game, delays in order processing, shipping, and receiving cause large oscillations in beer inventories. Students playing the game initially blame the individuals making the purchase decisions, but eventually realize that the oscillations are the fault of delays in the system itself.

Systems Thinking Lesson: Failure to understand that systemic structure often impacts business results more than individuals do.

4.4.2. Quality Assurance Targets

Many companies establish annual performance goals at the corporate, departmental, and individual levels. In one company, the quality assurance (QA) department was goaled with reducing the defect rate in a key product. The QA Director met with the Production Supervisor to discuss the issue; the Production Supervisor in turn spoke with his shop supervisors. A shop floor supervisor then told his machine operator that quality is extremely important, and that his salary increase will depend heavily on quality improvement. Yet, for the following three months, the number of defects on the individual's machine remained the same. The machine operator really wanted to reduce the number of defects but did not know how.

Systems Thinking Lesson: A defective Goals-Behaviors-Metrics-Rewards (GBMR) system. Establishing employee goals without elucidating exactly how (behaviorally) to achieve those goals is unwise.

4.5. Examples in Administration

4.5.1. Major League Baseball in the 1990s

In the 1990s, the conventional wisdom in major league baseball was to pay huge bucks for big-name stars. Team payrolls varied by a factor of 3, and those teams with smaller payrolls had trouble fielding championship teams. In the 2011 Columbia Pictures movie *Moneyball*, this problem is exemplified when Oakland Athletics general manager Billy Beane is confronted with the challenge of assembling a winning baseball team on a limited budget. Beane's assistant, Peter Brand, points out that the huge dollar, superstar mental model is flawed and that there is greater value in using *sabermetrics* to identify and hire lower-priced players who may have been overlooked; advice that Beane embraces. Using the technique to focus on On-Base Percentage (OBP), Beane assembles a team that makes

it all the way to the 2002 American League West title on a limited payroll. Other teams adopt the sabermetrics philosophy and two years later, the Boston Red Sox win the World Series using Beane's and Brand's novel mental model. This represents a paradigm shift in how baseball players are assessed and compensated.

Systems Thinking Lesson: An antiquated mental model with respect to how to assemble a winning team.

4.5.2. The New England Finned Fishing Industry's Decision to Take as Many Fish as Possible

Up until the 1980s, the finned fishing industry in New England was prosperous. When some noted that the fish stocks on George's Bank were being depleted and called for quotas on the amount of fish taken, the industry reacted violently, arguing that their survival depended on maximizing fishing hauls. There is a systemic feedback loop at work here: the more fish taken, the fewer remain for subsequent years. Of course, the unintended consequence was the rapid depletion of fish off New England waters and the concomitant demise of the industry; George's Bank was closed to fishing in 1994 and has not reopened.

This overlooked feedback loop is an example of the Tragedy of the Commons, in which competition for an underpriced resource results in its depletion as an unintended but inevitable consequence. Clearly, the fishermen did not understand the systemic implications of their practices. It is noteworthy that the Maine lobster industry, by using Systems Thinking and limiting fishing hauls, has remained stable and viable over the past 100 years.

Systems Thinking Lesson: Unintended consequences of a business decision.

4.5.3. The Common Business Decision to Cut R&D and Advertisements/Promotions When Sales Slip

A common business practice is to reduce Research and Development and Promotion/Advertising when sales slump. Of course, these functions are critical to the development of new products or services and the origination of new business; cutting them often leads to further reductions in sales. The result of this inattention to feedback is a short-term increase in profits and the unintended consequence of long-term losses.

Systems Thinking Lesson: Unintended consequences of a business decision.

4.5.4. Poor Justification for Hiring Additional Staff

Employees often feel that adding resources will increase profits but have trouble convincing their supervisors. In one case, a company had an excellent Regional Sales Manager (RSM) who was responsible for the western third of the U.S. He had two sales engineers and an administrative assistant working for him, and his region generated ~\$6 million in sales each year. At every opportunity, however, he complained to his boss (the V.P. of Sales) that he was missing half the sales opportunities in his vast region because he did not have enough staff. The V.P. was not convinced that the extra staff would pay off, so he kept denying the RSM's request. The RSM and the V.P. grew frustrated with each other and sales volume remained flat. In this case, the problem was that the corporate structure had separated accountability from authority in a command-control structure.

One may view a business as either a system in which employees simply execute decisions made by management (a command-control structure, much like the military) or as a system in which employees are motivated properly to make good business decisions themselves (a market-based structure [48]). If the employee is given both authority to make resource decisions and accountability for making them (see Figure 4), and their compensation is based on their performance (a market-based management structure), then there is no need for a command-control structure, the role of the supervisor is changed from an approver to a coach/mentor/obstacle-remover, and interpersonal frictions are reduced.

Systems Thinking Lesson: A poor business structure based on a poor mental model.

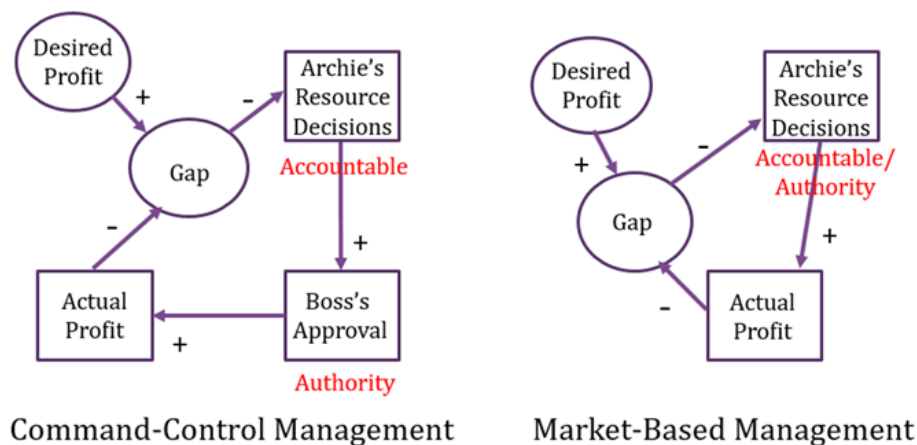


Figure 4. Systems Thinking in Hiring Accountability.

4.5.5. Conflicting Behavior Patterns

In some administrative situations, employees exhibit repeated patterns of conflicting behavior due to discrepant mental models. Consider the following scenarios:

- i. Every time Rick walks into his boss's office to ask for help, she yells at him. Had this occurred only once, it might not have been a systemic issue, but its repetition indicates a pattern, which is caused by structure, which, in turn, is caused by an underlying mental model. In this case, the boss may not feel she is responsible to help Rick (a structural issue), or she may feel that Rick should know the answers for which he is seeking help (a mental model), or Rick may be intruding upon her at an inconvenient time (structure and mental model). The situation is not likely to improve until the two sit down together and discuss both of their mental models with respect to the support to be provided Rick and the correct procedures for soliciting it.
- ii. Katie and Pete work on the same project team. In meetings and presentations, Katie repeatedly criticizes Pete's ideas, and Pete reacts negatively to the criticism. This pattern indicates an underlying structural issue that is engendered by mental models. Pete may not be following established procedures for implementing new ideas, or Katie may be overly assiduous in enforcing rules. Or, Katie may view Pete as a threat to her advancement within the company because corporate structure rewards people for new ideas. In any case, the situation may be addressed by analyzing the structure (rules, policies, procedures, etc.) and the underlying mental models held by both Katie and Pete as well as by their supervisor.
- iii. Employees are required to travel occasionally on business, and reasonable business expenses are reimbursed via the company's expense report system. Recently, almost every expense report submitted by employees in Department X has been rejected by Accounting, which is a new behavior pattern. The employees are growing frustrated and are considering refusing to travel on business because of the difficulty getting reimbursed. There is suspicion that the accounting clerks have been instructed to reject expense reports specifically to reduce expenses and improve the company's profit. This situation will not be addressed until all parties understand the rules and procedures for expenses (structure) and the underlying mental models that have contributed to them.

Systems Thinking Lesson: Discrepant Mental Models yielding unclear or suboptimal business structures. Table 2 offers a summary of business failures discussed with corresponding Systems Thinking Lessons.

Table 2. Overview of the Business Failures and Systems Thinking Lessons.

Business Failure	Systems Thinking Lesson
<i>Product Development and Product Life Cycle Management</i>	
The Microsoft Zune Polaroid	Failure to understand that many products are components of a <i>user experience system</i> Flawed Mental Model
RIM's Blackberry Swiss Watchmakers	Failure to understand that many products are components of a <i>user experience system</i> Flawed Mental Model/Paradigm Shift
<i>Sales and Sales Management</i>	
Missed Sales Targets for New Products Sales Management Sales Commission Structure	Sub-Optimal Structure A Defective Goals-Behaviors-Metrics-Rewards System/Sub-Optimal Structure Flawed Mental Model/Sub-Optimal Structure
<i>Pricing</i>	
Bank of America's Decision to Charge for Transactions	Unintended Consequences
Airlines' Charge for Checked Baggage	Unintended Consequences
National Park Service Entry Fees	Unintended Consequences
25% Price Increase	Unintended Consequences
<i>Operations and Quality Assurance</i>	
Poor Inventory Management QA Targets	Sub-Optimal Structure A Defective GBMR System
<i>Administration</i>	
Major League Baseball in the 1990s Finned Fishing Industry Policies Cutting R&D and Ad/Promo Structure for Hiring Staff Behavior Patterns	Flawed Mental Model Unintended Consequences Unintended Consequences Flawed Mental Model/Sub-Optimal Structure Discrepant Mental Models/Sub-Optimal Structure

It is interesting and fortunate that the Systems Thinking failures explaining these 18 problems fall into just 4 categories:

1. Failure to understand that "products" are really components of user experience systems;
2. Flawed or outdated mental models/paradigms;
3. Structure and unintended consequences: failure to heed feedback in the system;
4. Flaws in the Goals-Behaviors-Metrics-Rewards system.

It is also interesting to note that all the failures in *pricing* fall into one category, unintended consequences: failure to heed feedback in the system.

In the subsequent section we further expand on these to offer a simple but useful protocol for applying Systems Thinking concepts in business.

5. The Systems Thinking Process/Protocol for Business

Having reviewed some of the Systems Thinking successes and failures with respect to business, it is possible to use inductive logic to develop some rules of thumb for the proper application of Systems Thinking principles to business and management. These are not intended to be sequential steps, but instead fundamental Systems Thinking principles that should be followed. The basic principles are:

1. Design and sell user experience systems, not products or services;
2. Expose, understand, and develop shared mental models/paradigms;
3. Address structure and unintended consequences by identifying *feedback* in the workplace;
4. Optimize the Goals-Behaviors-Metrics-Rewards system.

These four basic principles are detailed below.

5.1. Design and Sell User Experience Systems, not Products or Services

As Norman [42] says, a product is more than just a product; most products and services are merely components of *user experience systems* that involve the product's acquisition, delivery, packaging, use,

support, maintenance, environment, disposal, and the product itself. Customers develop opinions based on all of these; a great product with poor maintenance and support is unlikely to be viewed favorably. Companies must take all these factors into consideration when producing products and services. So, when considering new products or services, companies should:

- a. Identify the user experience system in which the product/service fits;
- b. Identify all components of that user experience system. Include acquisition, delivery, packaging, use, support, maintenance, environment, and disposal, as well as the product itself;
- c. Ensure that all elements of the user experience system are focused on the user, not the company, and not the product;
- d. Structure the company to support this. Ensure that users will enjoy every part of the experience;
- e. Study Apple's development of the iPod user experience system for inspiration.

5.2. Expose, Understand, and Develop Shared Mental Models/Paradigms

Good mental models yield positive structures, and vice-versa. Mental models are the bottom level of the Iceberg Model (see Figure 1) and cause structures, behaviors, and patterns. For example, a mental model that incentive compensation increases productivity may yield a compensation structure that pays employees bonuses for new ideas or for exceeding targets. However, that same mental model and resulting structure may yield destructive competition and back-stabbing of colleagues. A mental model that prices must increase each year may result in tactical profit increases but long-term loss of business. Often, managers are not even aware of their own mental models and marvel at the company results caused by them. It is important to understand one's mental models and expose them to scrutiny, as well as others within (and outside of) the company. When business Key Performance Indicators do not meet expectations, managers should review their own mental models to see if they require modification. It is sometimes beneficial to have the management team sit together for the express purpose of reviewing corporate mental models. Mental models may include those focused on:

- a. Who is the market and how big it is;
- b. Attitudes of the market;
- c. Perceived value of the good/service;
- d. How to reach potential customers;
- e. The selling approach;
- f. Competition strengths and weaknesses;
- g. Our own competitive advantages;
- h. Employee motivation and incentive compensation;
- i. Desired employee skills and experience;
- j. The best way to produce and deliver the product or service.

5.3. Address Structure and Unintended Consequences by Identifying Feedback in the Workplace

Mental models engender business structures. Structure is the way that the system components interrelate in feedback loops and manifests itself as the company's rules, policies, procedures, authorities, and approval levels. Linear thinking fails to consider the many feedback loops inherent in businesses and, consequently, often results in unintended consequences. Although it is probably impossible to prevent ALL unintended consequences of business decisions, it should be possible to minimize them by understanding the systemic structures (specifically the feedback loops) that cause them. For example, raising prices increases short-term profit but negatively impacts sales volume and customer attitudes; consumption of resources increases short-term productivity but reduces the quantity of available resources in the future; reducing business origination systems saves money in the near-term but reduces future business. Linear thinkers often overlook the feedback loops, either inadvertently or *intentionally* to secure short-term profits at the expense of long-term consequences.

To avoid unintended consequences, identify the structures and the feedback loops in the company (see [49]). This can be accomplished using Systems Thinking tools, such as Stock-and-Flow diagrams and Causal Loop Diagrams (CLDs). For example, oscillations are almost always caused by feedback loops with *delays* [50]. In analyzing an oscillation in inventory levels, an analyst may develop the Causal Loop Diagram shown in Figure 5.

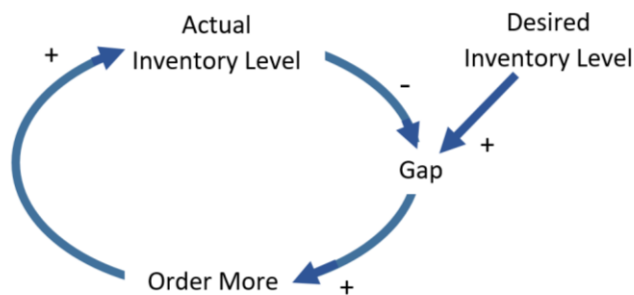


Figure 5. Inventory Causal Loop Diagram.

But this feedback loop would not yield oscillations. A more accurate CLD is shown in Figure 6, which depicts the delay.

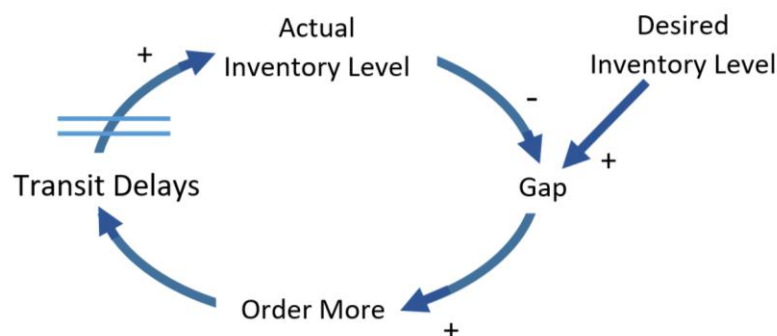


Figure 6. Corrected Inventory Causal Loop Diagram.

The solution is to first recognize that oscillations are caused by feedback loops with delays, then identify the delay(s), and then try to minimize or anticipate them.

It may be wise to schedule regular “unintended consequence” meetings to expose and discuss unintended results and trace back the underlying business structures and mental models that engendered them. Often, rules and procedures are amended and modified over time, leading to “Rube Goldberg” structures. In other cases, situations change and the policies are no longer current or valid. It is wise to review company rules, policies, procedures, protocols, incentives, and structures regularly, and to map out corresponding Causal Loop Diagrams, to ensure that they are yielding desired behaviors. Employees and customers affected by the policies and procedures should be included in these discussions.

Some of the more common causes of unintended consequences are pricing decisions, employee incentive structures, company reorganizations and structural changes, systemic delays, and resource utilization decisions. Monat and Gannon [49] provide several more examples of the application of Systems Thinking tools to correct unintended consequences in a sales organization.

5.4. Optimize the Goals-Behaviors-Metrics-Rewards System

One of the strongest systems thinking structures in any company is the Goals-Behaviors-Metrics-Rewards (GBMR) system, which is fundamentally a *feedback system* that positively reinforces employees for desirable behavior and negatively reinforces them for undesirable behavior, as shown in Figure 7.

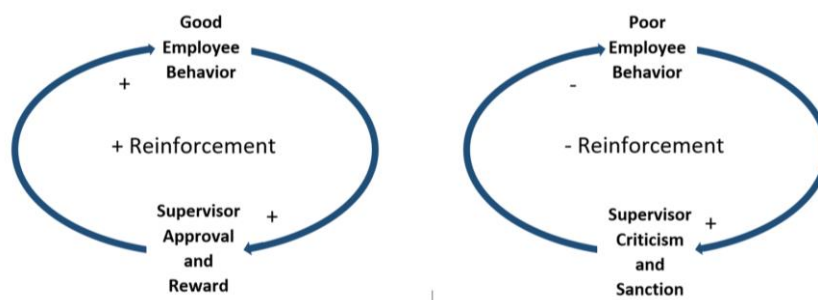


Figure 7. Employee-Supervisor Feedback Loops.

This system attempts to establish goals for employees and reward them for achieving those goals; ostensibly if all employees achieve their goals, the company will prosper. But many companies execute this poorly. In Reference [51], Monat asserts that many managers articulate incorrect goals, fail to articulate desired behaviors, and establish metrics and rewards that are counter-productive.

Organizational Goals are hierarchical and start at the top of the company (Board of Directors, CEO, President) and percolate down through the organization. They should be different for each group and individual, with the lower level goals supporting the next level above. Goals should mesh and support each other both vertically and horizontally. They must be accurate: do not say “increase sales” if you mean “increase sales and profit”; do not say “improve delivery” if you mean “improve delivery without compromising quality and cost” (these are examples of the “seeking the wrong goal” archetype). Most (but not all) goals should be quantitative and most should be process-based as opposed to function-based (process-based goals penetrate across many divisions of a company, whereas function-based goals are within a division).

Behaviors are also hierarchical, like goals. Behaviors derive from goals, yet many managers fail to translate goals into desired behaviors, which describe what an employee must do to achieve the goals. Behaviors are developed jointly by the employee and the employee’s supervisor. Note that two individuals with the same title may have different desired behaviors—they are tailored to the individual. Suppose a salesperson’s goal is to increase sales volume by 10% over last year without lowering prices or providing more services for free. An agreed-upon behavior might be, “This year I will spend 50% less time dealing with customer issues (by passing them off to Customer Service) and 50% more time following up on screened leads provided to me by the Business Origination group. I will also contact every current customer listed in our Customer Relationship Management system to try to expand sales to them.”

Metrics: Most goals are measured. However, it is important to also measure behaviors. Sometimes, these are hard to quantify. But ask, “How do I know if they are doing a good job?” If the desired behaviors have been articulated well, measuring them is straightforward. In the above example, it is a simple matter to measure, during the course of the year, if the salesperson is dealing with fewer customer problems and spending more time pursuing screened leads and contacting existing customers.

Rewards: Rewards are part of the systemic structure. Rewards are tools to encourage desired behavior and are components of the reinforcing feedback loop depicted in Figure 7. They should be within the company’s financial constraints, immediately and clearly linked to the behavior that yielded the reward, significant to the employee (per Maslow’s hierarchy), and at the discretion of the immediate supervisor (within reasonable bounds). Examples of good rewards include a case of gourmet foods (for a food connoisseur), a day off with pay, additional responsibility for someone who craves that, the opportunity to present a paper for someone who craves prestige and respect, a free dinner out for the employee and their spouse, and the ability to come in late after working extremely hard one week. Examples of bad rewards include commissions paid at year-end (the association between the behavior and the reward is too far separated), a \$50 gift certificate for a million-dollar sale (the scale of the reward is incommensurate with the achievement), and a gold Cross pen and pencil set to an individual who can barely pay their bills (inconsistent with Maslow’s hierarchy).

In summary, an optimized GBMR System has:

1. Clear and reasonable goals, based on hierarchy;
2. Behaviors defined by supervisors and their employees that, if effected, will lead to goal achievement;
3. Metrics that accurately measure behaviors, not goals;
4. Rewards that motivate.

For a more extensive discussion on an optimized GBMR system the reader is referred to [51].

6. Conclusions

Businesses are systems, the components of which include products and/or services, the physical building and its contents, employees, customers, stakeholders, management, the environment, regulatory agencies, banks, suppliers, communications vehicles, transportation services, performance metrics, and other factions. These components interact in complex and sometimes surprising ways. Systems Thinking is a perspective, a set of tools, and a language that may be used to understand and optimize system behavior. Yet, Systems Thinking is not used extensively in business management.

In this paper we discussed several business failures and identified Systems Thinking lessons that could be applied to avert such failures with the goal of communicating these concepts at the level of the practitioner. We synthesized these lessons into a simple, practical framework for Systems Thinking in business. The approach taken here was inductive and was not intended to follow the rigor of a deductive scientific theory. Future work building on this is proposed to validate and refine the proposed approach in the context of real case studies.

Many of the Systems Thinking concepts described in this paper are not new, but many practitioners fail to apply them in a business environment. We believe that this is because experience alone does not ensure that we do not repeat our mistakes. Disparate mental models, unintended consequences of decisions, poor employee rewards systems, and bad pricing decisions have all been observed and documented, yet those errors are repeated. To be useful, experiential learning must be organized into some convenient, logical format that is easily accessible: a paradigm. The Merriam-Webster dictionary defines “paradigm” as “a philosophical and theoretical framework of a scientific school or discipline within which theories, laws, and generalizations and the experiments performed in support of them are formulated.” It would be much easier for business managers to avoid these types of mistakes if there were a Systems Thinking paradigm that could be applied as Standard Operating Procedure for businesses. It is our hope that the Systems Thinking business protocol described here constitutes this paradigm and will minimize these errors going forward.

Author Contributions: All authors contributed to the conceptualization of the content for this paper. In addition, Matthew Amisshah conducted the research for and prepared the initial draft of the literature review in Section 3, as well as the final formatting of the paper, including the citations to the references. Jamie Monat and Thomas Gannon conducted the research for and prepared the initial draft of the examples contained in Section 4, as well as the basic principles for the proper application of Systems Thinking principles to business and management in Section 5. All authors contributed to the introduction to Systems Thinking in Section 2, the conclusions in Section 6 and the review of the final draft of this paper. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Monat, J.P.; Gannon, T.F. What is systems thinking? A review of selected literature plus recommendations. *Am. J. Syst. Sci.* **2015**, *4*, 11–26.
2. Senge, P.M. *The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization*; Crown Business: New York, NY, USA, 2014.
3. Kim, D.H. *Introduction to Systems Thinking*; Pegasus Communications: Waltham, MA, USA, 1999.

4. Monat, J.P. *SYS 540 Introduction to Systems Thinking (Lecture Notes)*; Worcester Polytechnic Institute: Worcester, MA, USA, 2019.
5. Checkland, P. *Systems Thinking, Systems Practice*; J. Wiley: Hoboken, NJ, USA, 1981.
6. Jackson, M.C. The origins and nature of critical systems thinking. *Syst. Pract.* **1991**, *4*, 131–149. [[CrossRef](#)]
7. Checkland, P.B.; Haynes, M.G. Varieties of systems thinking: The case of soft systems methodology. *Syst. Dyn. Rev.* **1994**, *10*, 189–197. [[CrossRef](#)]
8. Beer, S. *Cybernetics and Management*; English Universities Press: London, UK, 1959.
9. Beer, S. *Brain of the Firm: A Development in Management Cybernetics*; Herder and Herder: New York, NY, USA, 1972.
10. Beer, S. *The Heart of Enterprise*; John Wiley & Sons: Hoboken, NJ, USA, 1979.
11. Beer, S. The viable system model: Its provenance, development, methodology and pathology. *J. Oper. Res. Soc.* **1984**, *35*, 7–25. [[CrossRef](#)]
12. Schwaninger, M. Design for viable organizations: The diagnostic power of the viable system model. *Kybernetes Int. J. Syst. Cybern.* **2006**, *35*, 955–966. [[CrossRef](#)]
13. Jose, P.R. *Design and Diagnosis for Sustainable Organizations: The Viable System Method*; Springer Science & Business Media: Berlin/Heidelberg, Germany, 2012. [[CrossRef](#)]
14. Forrester, J.W. Industrial Dynamics. A major breakthrough for decision makers. *Harv. Bus. Rev.* **1958**, *36*, 37–66.
15. Forrester, J.W. Urban dynamics. *IMR Ind. Manag. Rev. (pre-1986)* **1970**, *11*, 67. [[CrossRef](#)]
16. Forrester, J.W. *World Dynamics*; Wright-Allen Press: Cambridge, MA, USA, 1971.
17. Sterman, J.D. Modeling managerial behavior: Misperceptions of feedback in a dynamic decision making experiment. *Manag. Sci.* **1989**, *35*, 321–339. [[CrossRef](#)]
18. Morecroft, J.D.; Asay, D.; Sterman, J.D. *Modeling for Learning Organizations*; Productivity, Incorporated: Shelton, CT, USA, 1994.
19. List of All Cases. Available online: <https://www.systemdynamics.org/list-of-all-cases> (accessed on 24 March 2019).
20. Stacey, R.D. *Complexity and Creativity in Organizations*; Berrett-Koehler Publishers: San Francisco, CA, USA, 1996.
21. Stacey, R.D. *Tools and Techniques of Leadership and Management: Meeting the Challenge of Complexity*; Routledge: Aberdeen, UK, 2012.
22. North, M.J.; Macal, C.M. *Managing Business Complexity: Discovering Strategic Solutions with Agent-Based Modeling and Simulation*; Oxford University Press: New York, NY, USA, 2007.
23. Checkland, P.B. Soft systems methodology. *Hum. Syst. Manag.* **1989**, *8*, 273–289. [[CrossRef](#)]
24. Scholes, J.; Checkland, P. *Soft Systems Methodology in Action*; Wiley: Chichester, UK, 1990; Volume 876, p. 910.
25. Maqsood, T.; Finegan, A.D.; Walker, D.H. Five Case Studies Applying Soft Systems Methodology to Knowledge Management. 2001. Available online: <https://eprints.qut.edu.au/27456/1/27456.pdf> (accessed on 1 May 2020).
26. Ackoff, R.L. Systems, messes and interactive planning. *Soc. Engagem. Soc. Sci.* **1997**, *3*, 417–438.
27. Beer, S. *Beyond Dispute: The Invention of Team Syntegrity*; Wiley: Hoboken, NJ, USA, 1994.
28. Flood, R.L.; Jackson, M.C. *Critical Systems Thinking*; Springer: Berlin/Heidelberg, Germany, 1991.
29. Jackson, M.C. Creative problem solving: Total systems intervention. In *Systems Methodology for the Management Sciences*; Springer: Berlin/Heidelberg, Germany, 1991; pp. 271–276.
30. Von Bertalanffy, L. General system theory. *Gen. Syst.* **1956**, *1*, 11–17.
31. Kast, F.E.; Rosenzweig, J.E. General systems theory: Applications for organization and management. *Acad. Manag. J.* **1972**, *15*, 447–465. [[CrossRef](#)]
32. Forrester, J.W. Industrial dynamics. *J. Oper. Res. Soc.* **1997**, *48*, 1037–1041. [[CrossRef](#)]
33. Rebovich, G., Jr.; White, B.E. *Enterprise Systems Engineering: Advances in the Theory and Practice*; CRC Press: Charaton, FL, USA, 2016.
34. Churchman, C.W. *The Systems Approach*; Delacorte Press: New York, NY, USA, 1968.
35. Churchman, C.W. *The Design of Inquiring Systems: Basic Concepts of Systems and Organization*; Basic Books: New York, NY, USA, 1971.
36. Mason, R.O.; Mitroff, I.I. *Challenging Strategic Planning Assumptions: Theory, Cases, and Techniques*; John Wiley & Sons Inc: Hoboken, NJ, USA, 1981.
37. Eden, C. Cognitive mapping. *Eur. J. Oper. Res.* **1988**, *36*, 1–13. [[CrossRef](#)]
38. Bennett, P.G.; Huxham, C.S. Hypergames and what they do: A ‘soft OR’ approach. *J. Oper. Res. Soc.* **1982**, *33*, 41–50.

39. Ulrich, W. *Critical Heuristics of Social Planning: A New Approach to Practical Philosophy*; Wiley: Chichester, UK, 1994.
40. Senge, P.M. *The fifth Discipline: The Art and Practice of the Learning Organization*, 1st ed.; Doubleday/Currency: New York, NY, USA, 1990.
41. Ballé, M. *Managing with Systems Thinking: Making Dynamics Work for You in Business Decision Making*; McGraw-Hill International (UK): Maidenhead, UK, 1994.
42. Norman, D.A. The way I see it, Systems thinking: A product is more than the product. *Interactions* **2009**, *16*, 52–54. [[CrossRef](#)]
43. Smith, A.N. What was Polaroid Thinking? Yale Insights, 2009. Available online: <https://insights.som.yale.edu/insights/what-was-polaroid-thinking> (accessed on 1 May 2020).
44. Gustin, S. The fatal mistake that doomed blackberry. Time Magazine, 2013. Available online: <https://business.time.com/2013/09/24/the-fatal-mistake-that-doomed-blackberry/> (accessed on 1 May 2020).
45. Barker, J.A.; Stiever, G. *Joel Barker's The New Business of Paradigms*; Star Thrower Distribution: Minneapolis, MN, USA, 2001.
46. Moore, G. Occupy Wall Street: One. Bank of America: Zero. Boston Business Journal 2011. Available online: https://www.bizjournals.com/boston/blog/bottom_line/2011/11/occupy-wall-street-one-bofa-zero.html (accessed on 1 May 2020).
47. Ngo, S. This Is the No. 1 Most Hated Industry in America, According to Real Customers. Available online: <https://www.cheatsheet.com/money-career/most-hated-industries-in-america-according-to-customers.html/> (accessed on 25 March 2020).
48. Gable, W.; Ellig, J. *Introduction to Market-Based Management*; Center for the Study of Market Processes: Fairfax, VA, USA, 1993.
49. Monat, J.P.; Gannon, T.F. *Using Systems Thinking to Solve Real-World Problems*; College Publications: London, UK, 2017.
50. Monat, J. Explaining natural patterns using systems thinking. *Am. J. Syst. Sci.* **2018**, *6*, 1–15.
51. Monat, J. The integrated approach to optimizing productivity. *WorldatWork J.* **2005**, *14*, 61.



© 2020 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).