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Enterprise Relationship Management, Operating Condition Dynamics, and the Relevance of Non-financial Information for Management Decisions

Approved by
Dissertation Committee:

William R. Kinney, Supervisor

Enterprise Relationship Management, Operating Condition Dynamics, and the Relevance of Non-financial Information for Management Decisions

by

Marcia Lynne Weidenmier, B.B.A., M.B.A.

Dissertation

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Dedication

This dissertation is dedicated to my parents, Carl and Mary Weidenmier, and my brother, Marc, for their love, support, and encouragement.

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Enterprise Relationship Management, Operating Condition Dynamics, and the Relevance of Non-financial Information for Management Decisions

Publication No._____

Marcia Lynne Weidenmier, Ph.D.

The University of Texas at Austin, 2000

Supervisor: William R. Kinney, Jr.

This study employs a system dynamics approach to examine the time-series of incremental profits achievable by incorporating a chain of non-financial measures into the internal decision-making process as several conditions change. The profitability model is based on enterprise relationship management concepts that posit a cause-and-effect chain from employee behavior to customer behavior to profits. Conditions include (1) the number of periods (or time-lag) for changes to affect financial performance, (2) measurement error of non-financials, and (3) product demand volatility. The research also investigates how the benefits change when non-financial measures are used with varying frequency in decision-making.

Simulation results show that integrating employee satisfaction and customer satisfaction measures into the decision process can generate higher profits than basing decisions on financial measures alone, because integration improves the timing of managerial expenditure decisions and reduces the variability of the decision environment. The financial benefits, however, are affected by a variety of factors including how managers incorporate the non-financials into decision-making. Specifically, non-financial measures are less beneficial when they are measured infrequently or when only a subset of the relevant measures is used.

Variation in operating conditions also greatly influences the magnitude and timing of the financial benefits. When demand is volatile, firm performance improves because non-financial measures help determine if demand changes are due to changes in (more) controllable factors, such as employee satisfaction and customer satisfaction, or due to changes in uncontrollable factors, such as a recession. On the other hand, measurement error as well as unpredictable satisfaction shocks reduce the benefits. As the time-lag grows longer, using non-financial measures improves financial performance but increases the length of time required to see the positive effects. In fact, operating and financial results decrease before rapidly increasing. Thus, the longer a firm has used non-financial measures in decision-making, the higher the probability that the non-financials are positively influencing performance.

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Chapter 1: Introduction

1.1 OVERVIEW

We are in the midst of a revolutionary transformation – Industrial Age competition is shifting to Information Age competition.[1] During the Industrial Age (1850 – 1975), success was based on the firm's use of its tangible assets to create efficient, mass production systems for standardized products. Companies served local markets and the competitive environment was generally stable and evolved slowly over time. Given this environment, historical financial performance was a good indicator of future financial performance and therefore asset and liability management was appropriately based on financial measures (FMs).

In the Information Age (1975 -), however, companies must now provide customized products and services, which have increasingly shorter life-cycles, at a low cost to rapidly changing, increasingly competitive, global markets. Financial success is based on high quality products and services, streamlined internal processes, motivated and skilled employees, and satisfied and loyal customers. Managers need (and want) non-financial measures (NFMs), or leading indicators of financial performance, which capture these intangible aspects of the firm's operations.

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[1] Kaplan and Norton [1996b] describe how the transformation from the Industrial Age to the Information Age changed the competitive environment as well as managers' accounting needs.

This study investigates the extent to which the integration of NFMs with FMs affects firm profitability under various operating conditions. Applying a system dynamics methodology, it examines the time-series behavior of incremental profits that can be achieved by incorporating a chain of NFMs into the internal decision-making process as several conditions change. To gain insight into the cost-benefit relation of NFMs, the study analyzes several properties of the time-series, including the relative risk, payback periods, expenditure decisions of managers, and NFM measurement frequency.

NFMs potentially anticipate problems, identify financial performance drivers or causes, explain financial results [Atkinson et al., 1997, p. 55], and provide timely feedback information about environmental changes and strategy implementation. Thus, integrating NFMs into internal decision-making should improve firm performance. Some empirical research studies find support for the proposed relation between the use of NFMs and improved financial performance, but others do not. However, due to a number of factors (primarily measurement difficulties), few studies (and few firms) are able to determine if the benefits exceed the costs of incorporating NFMs into the decision process [American Productivity and Quality Center, 1996; Ittner and Larcker, 1998b]. By examining the evolution of a business process model through time as two NFMs, employee and customer satisfaction, are used in decision-making, this study attempts to (1) help managers understand the relative costs and benefits of NFM usage and (2) reconcile the inconsistent results of prior studies.

This study implements a specific type of enterprise relationship management, the Employee-Customer-Profit chain (ECP), that assumes a chain of cause-and-effect running from employee behavior to customer behavior to profits [Reichheld and Teal, 1996]. Specifically, the ECP holds that firms should compensate employees well and create a positive working environment to maintain high employee satisfaction levels. Satisfied employees are not only more loyal to the firm, but they also reward the firm with lower employee turnover, higher productivity, and better customer service. This environment creates satisfied customers, lower customer turnover, and eventually higher profits because customers are buying more products and providing the firm with positive word-of-mouth advertising. Thus, to be successful, managers must manage relationships with employees and customers.

Using the above ECP model, this study investigates how changes in key conditions may affect the incremental operational and financial benefits of incorporating NFMs in managerial decision-making. Theoretically, integrating NFMs into the decision process should generate higher profits than basing decisions on FMs alone, but the benefits that can be achieved from incorporating NFMs are predicted to vary as operating conditions, which may not be under the firm's control, change. To determine the relative costs and benefits, I simulate a time-series of internal and external events, apply alternative measurement schemes, and then capture changes in decisions and outcomes as the following three conditions vary.

The first condition examines Time-Lag, the number of periods that it takes for changes in non-financial factors (or true, error free NFMs) to affect subsequent NFMs and FMs. The expectation is that increasing Time-Lag should increase the benefits from incorporating NFMs into the decision process. The increase should result from the ability of the NFMs to identify and correct operating problems before the FMs identify the problem.

The second condition, NFM Measurement Error, captures the inherent relevance-reliability tradeoff of NFMs. While NFMs may be more relevant than FMs for managerial decision-making, they may not be very reliable due to measurement difficulties. Decreasing the reliability of the NFMs should reduce the benefits associated with NFMs because as the reliability of the NFMs decreases, managers are basing decisions on (increasingly) imprecise information and are more likely to make decisions that may adversely affect the firm.

Finally, the third condition examines the impact of Demand Volatility. It is expected that as the uncertainty of demand increases (i.e., higher volatility), the value of NFMs should increase because NFMs are timelier revenue drivers and help stabilize internal operations by reducing uncertainty, therefore helping to reduce the impact of external events on the firm. No predictions are made for the interactions of the three conditions.

1.2 METHOD OF INVESTIGATION

A system dynamics approach is employed to study the impact of NFMs on decision-making. System dynamics is used to investigate the information-

feedback character of organizational systems.[2] A simplified, but realistic, model of business processes is analyzed using computer simulation, which compresses time and space, allowing a study of the dynamics of the model over an extended period of time as selected conditions change. One of the greatest benefits of simulation is that it permits alternative decisions and actions to be compared in order to determine the best operating policies. Thus, system dynamics helps improve managerial effectiveness and firm performance by understanding the long-term behavior of the organization for a given policy [Forrester, 1961; Richmond and Peterson, 2000; Sterman, 1994; and Sterman, 2000].

A system dynamics model of the ECP philosophy, described in Section 1.1, is developed. The model incorporates: (1) the underlying principles of the ECP, (2) the three conditions of interest (Time-Lag, NFM Measurement Error, and Demand Volatility), (3) "real world" random shocks that may inexplicably and unpredictably affect employee satisfaction and customer satisfaction, and (4) alternative decision rules, which are described below.

The ECP model is placed in a decision setting reflecting the fact that managers with "bounded rationality" adopt simple rules for decision-making [March and Simon, 1958; Etzioni, 1989; Shoham, 1999]. Specifically, the manager's decision framework assumes the only variable he/she can manipulate to maximize net income is the level of expenditures needed to increase employee

[2] "An information-feedback system exists whenever the environment leads to a decision that results in action which affects the environment and thereby influences future decisions" [Forrester, 1961, p. 14].

satisfaction. Furthermore, the manager makes his/her expenditure decision at the beginning of every period based on the decision framework.

A decision framework provides the decision rule and the information set available to managers for expenditure decisions. Two main decision frameworks are compared – an integrated structure with both FMs and NFMs and a strictly FM structure. In a business with defined enterprise relationship management and NFM causal links, the Always NFM decision framework measures both NFMs and FMs, allowing a firm to incorporate NFMs, employee and customer satisfaction, into the decision process along with FMs. The No NFM decision framework measures only financial results and the firm makes decisions based on only a FM, net income.

To understand the impact of NFM measurement frequency, a third decision framework, Intermittent NFM, is also studied. This framework is a hybrid of the Always NFM and No NFM decision frameworks, supplementing the FMs with NFMs every fourth period. The Intermittent NFM decision framework reflects how many firms incorporate NFMs into their decision-making – only on an annual basis. A comparison of the Always NFM results with the Intermittent NFM results shows the relative benefits of incorporating NFMs into decision-making on a frequent and infrequent basis.

Simulation allows a comparison of these three decision frameworks. To evaluate the pattern of costs and benefits from introducing NFMs into the managerial decision process, the ultimate decisions and financial outcomes of each decision framework must be compared over an extended period of time.

Assessing the benefits in the "real world" is difficult due to the complexities of modern business, which make it hard to isolate the effect of NFMs. Moreover, studying the long-term effect of NFMs is difficult because firms either have not used the measures for a long period of time or have abandoned them after a short trial period.

In addition, conducting experiments on real firms is impractical due to the time required and the difficulty in creating ceteris paribus conditions. Creating a tractable analytic model requires highly restrictive assumptions about the number of time periods, the relation between NFMs and FMs, as well as the number of changing conditions. Simulation, on the other hand, generates an extended time-series of data, isolates the impact of NFMs by changing all internal and external conditions simultaneously for the alternative decision frameworks, routinizes the decision rule, and therefore directly compares decision-making results with and without NFMs.

1.3 RESULTS

The results indicate that the impact of using NFMs in decision-making depends on a variety of factors including the operating environment, how managers are incorporating NFMs into decision-making, and how long the firm has been using NFMs. When demand is volatile, using NFMs increases firm performance because NFMs allow the firm to determine if demand changes are due to changes in more controllable factors, such as employee satisfaction and customer satisfaction, or due to changes in uncontrollable factors, such as a

recession. On the other hand, NFM Measurement Error as well as employee satisfaction and customer satisfaction shocks reduce the benefits of using NFMs.

To maximize performance, managers must incorporate NFMs on a (frequent) consistent basis and use the appropriate decision rules. Managers also need to incorporate all relevant NFMs and FMs. Sub-par results are achieved if managers only use part of the NFM chain, especially the end, to make decisions. Different relative weights on the individual NFMs and FMs in the decision-making rules also change the benefits.

As the Time-Lag grows longer, NFM usage improves financial performance but increases the length of time required to see the positive effects. In fact, after NFMs are incorporated into decision-making, operating and financial results initially decrease before rapidly increasing. Moreover, the positive benefits associated with NFM usage when Time-Lag is long may eventually overcome the negative effects of NFM Measurement Error. Thus, the longer the period of time that NFMs have been incorporated into decision-making, the higher the probability that the NFMs are positively influencing performance.

1.4 CONTRIBUTIONS

This study expands our understanding of the importance of NFMs with respect to the managerial decision process in several ways. This study examines NFMs using a different methodology, system dynamics/simulation. David Norton, co-author of the Balanced Scorecard, states that "[t]he next generation of Balance Scorecard will be built using Dynamic Simulation" [High Performance

Systems, 2000]. Accordingly, this study uses a system dynamics model to analyze NFM usage. A dynamic model means that unlike most empirical and analytic studies that assume unchanging, linear relationships between business components (and measures), this study uses closed-loop, causality relationships which reflect the interconnected and continuously evolving "real world." Thus, this study attempts to expand our understanding of NFMs using a methodology that captures the closed-loop/information-feedback relationships that drive businesses.

The system dynamics methodology also allows the current study to contribute to research in several areas. First of all, the study attempts to directly assess the benefits of integrating NFMs into decision-making. Prior empirical studies cannot make this assessment because (real) firms cannot contemporaneously operate in a dual-decision world. Therefore, most extant literature has only *indirectly* studied the importance of NFMs, focusing on the historical relationship of *available* NFMs with earnings, returns, and prices at the firm level.

Second, because the methodology can manipulate the selected conditions while controlling all other external and internal conditions, the study gains new insights into how select conditions affect the benefits of integrating NFMs into decision-making. A few extant studies examine how strategy and firm structure may affect the benefits of using NFM, but this study specifically examines how changing information conditions affect the pattern of costs and benefits of NFM usage. An understanding of the pattern of costs and benefits is needed to help

explain the mixed results of NFM usage by businesses and NFM empirical research.

Finally, system dynamics/simulation permits NFMs to be studied over a long time horizon. In contrast, prior NFM studies generally examine a short period of time, 2 or 3 years of data, because most firms have recently begun using NFMs in decision-making. A long time window is necessary to examine the pattern of costs and benefits of these forward-looking, NFMs.

1.5 LIMITATIONS

This study has three primary limitations. The first limitation is that the ECP model is implemented with simulated data. Nevertheless, the data possess the characteristics of actual firm data and are used consistently across the decision frameworks to assess the relative effect of changing conditions.[3] Moreover, "for many purposes, values of parameters anywhere within the plausible range will produce approximately the same results" [Forrester, 1961, p. 171]. The results of the study should, therefore, be a good indicator of "real world" behavior.

The second limitation is inherent in the system dynamics methodology. Specifically, simplifying assumptions must be made to simulate the ECP model. While I attempt to make the assumptions mirror the real world conditions, assumptions must be made that simplify real world phenomenon. However, this disadvantage is also an advantage in that the simplified world allows three key conditions to be isolated and examined. A thorough understanding of a simplified

[3] "Understanding the physics of a business does not require precise numbers. However, the numbers must make sense relative to each other" [High Performance Systems, 1997, p. 74].

world is necessary before adding additional complexities to the model. Furthermore, the system dynamics model attempts to capture the essence of the system without clouding the picture with extraneous detail that would hide the behavior patterns of interest [Richmond and Peterson, 2000, p. 8-3].

The third limitation is that only one business model, enterprise relationship management, is studied. This model, however, is becoming increasingly important as business becomes more competitive, employee tenure decreases (draining intellectual capital from the firm), and customer power increases. Given this environment, a growing number of firms are attempting to manage employee satisfaction and customer satisfaction to maximize profitability. The paper provides a starting point for additional research in this area. Future research can examine whether the results generalize to other NFMs, business models, and changing conditions.

1.6 OUTLINE OF DISSERTATION

The remainder of this dissertation is organized as follows. Chapter 2 describes the growing importance of NFMs in managerial decision-making, summarizes extant NFM research providing motivation for the study, and introduces the business process model conditions investigated in this study. Chapter 3 develops the model and methodology in detail, while Chapter 4 summarizes the results of the system dynamics simulation. Chapter 5 concludes with the contributions, implications, and limitations of this dissertation, as well as with some suggestions for future research.

Chapter 2: Theoretical Development and Studied Conditions

2.1 Overview

This chapter has three purposes. The first purpose is to motivate the study by initially discussing the growing importance of non-financial measures (NFMs) in managerial decision-making and then by describing the current state of knowledge with respect to NFMs. The second purpose is to introduce the conditions examined. In doing so, the study offers additional explanations for the mixed results of extant NFM studies as well as a discussion of why NFM usage may be beneficial for some firms but not others. The third purpose is to introduce the specific business process model used to investigate financial measures (FMs) and NFMs in decision-making.

2.2 NFMs in Managerial Decision-Making

We are in the midst of a revolutionary transformation – Industrial Age competition is shifting to Information Age competition.[4] During the Industrial Age (1850 – 1975), success was based on the firm's use of its tangible assets to achieve economies of scale and scope. Therefore, companies imbedded technology into physical assets to create efficient, mass production systems for standardized products. Companies served local markets and the competitive environment was generally stable and evolved slowly over time.

[4] For additional information regarding the transformation from Industrial Age to Information Age competition, see Kaplan and Norton, 1996b.

Given this environment, historical financial performance was a good indicator of future financial performance. Asset and liability management was appropriately based on financial performance measures, such as return on capital employed, stored in financial accounting information systems. FMs were stressed over NFMs, which were used solely to monitor firm production and were relegated to (stand-alone) management accounting systems.

In the Information Age (1975 -), however, the business environment has changed. Companies must now provide customized products and services, which have increasingly shorter life-cycles, at a low cost to global markets. Business competition is increasing [Zornes, 1999]. The corporate emphasis is on intangible assets (i.e., employees, customers and suppliers), which create longer-term value. Thus, Information Age companies must be equipped to handle a rapidly changing, global environment.

To compete in this environment, managers require an expanded set of decision-making information, because the traditional financial accounting model does not support Information Age competition. Specifically, financial accounting measures are historical, myopic, aggregate, and focus primarily on tangible assets.[5] The financial success of Information Age companies is based on high quality products and services, streamlined internal processes, motivated and skilled employees, and satisfied and loyal customers. Managers need NFMs, or leading indicators of financial performance, which capture these intangible aspects of the firm's operations.

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[5] For additional perceived limitations of FMs and reasons for adapting NFMs, see Ittner and Larcker, 1998b.

Moreover, recent advances in information technology (e.g., enterprise resource planning systems) allow firms to capture and integrate needed non-financial and financial information on a real-time, cross-functional basis. NFMs help identify problems and the appropriate corrective actions better than FMs because NFMs can be monitored in more detail. NFMs also speed up the decision process, broaden managers' perspectives, and facilitate double-loop learning [Kalagnanam and Krueger, 1998a]. Learning is the ability to detect and correct errors when there is a mismatch between the pre-specified goal and the actual outcome, while double-loop learning requires an understanding and continual updating of the cause-and-effect relation between actions and outcomes [Argyris, 1993].[6] Thus, providing managers with integrated FMs and NFMs should improve operating decisions and ultimately financial performance.

In order to expand the traditional financial accounting model to incorporate NFMs into decision-making, Kaplan and Norton created a new strategic measurement system called the Balanced Scorecard. The Balanced Scorecard enlarges the traditional focus of performance measurement systems from a financial perspective to four dimensions (financial, customer, organizational learning, and business processes) which are all linked to the firm's strategy. This expansion allows (and forces) managers to consider all operational measures together, reveals the tradeoffs already made among performance

[6] The claim of double-loop learning, however, is in contrast to two studies which find that executives have difficulties in linking key NFMs with financial performance or stock returns [Brancato, 1995; Ittner and Larcker, 1998b], suggesting that NFMs are not facilitating double-loop learning (or alternatively that firms are measuring the wrong NFMs).

measures, and encourages them to achieve their future goals without making unnecessary tradeoffs [Kaplan and Norton, 1993, p. 135].

Despite the focus on NFMs, the Balanced Scorecard does not exclude financial performance. Instead, the Scorecard maintains a strong link with financial outcomes by tying the customer perspective, organization learning, and business process measures to current and future financial performance.[7] Its success is due to the fact that it enables companies to simultaneously track short-term financial results and monitor their progress in: (1) building necessary capabilities, and (2) acquiring the intangible assets that generate growth for future financial performance [Kaplan and Norton, 1996c, p. 18].[8]

Changes in the work environment are also making managers monitor NFMs, especially employee satisfaction and customer satisfaction, more closely [Baum, 1999; HR Focus, 1999]. Unlike the producer-dominated Industrial Age, economic power has shifted from producers to employees and consumers in the Information Age [Baum, 1999; HR Focus, 1999; Petzinger, 1999]. With respect to employees, not only has employment tenure decreased but hiring/training costs have escalated to as much as $30,000 per employee or three times the salary level [Weaver, 1999]. Thus, employers are monitoring employee satisfaction in order to reduce turnover costs [HR Focus, 1999].

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[7] For example, "[r]ecent work in the service profit chain has emphasized the causal relationships among employee satisfaction, customer satisfaction, customer loyalty, market share, and eventually, financial performance" [Kaplan and Norton, 1996d, p. 63].

[8] Some firms use five or six categories of performance measures instead of the four proposed by the Balanced Scorecard. The Balanced Scorecard described above outlines the basic methodology no matter how many categories are used.

With respect to consumers, not only do customers have high, if not world-class, service expectations but they also have a new weapon, the Internet, to help them achieve that goal [Baum, 1999]. The Internet allows customers to vent complaints worldwide about a company's products or services at a minimal cost and effort.[9] For example, a Buy.com customer, Phil Van Der Vossen, launched an anti-Buy.com web-site (www.buycrap.cjb.net) expressing his dissatisfaction and warning other consumers not to buy from the on-line company. Furthermore, companies are establishing web-sites for consumers to rate products on-line (i.e., deja.com), making customer satisfaction ratings readily-available to everyone. Unfavorable ratings or bad publicity on-line can threaten a firm's future profitability because an unlimited number of existing and potential customers may be discouraged from ever buying a firm's product [Beck, 1999]. Thus, monitoring NFMs and correcting problems as soon as possible is increasingly important in this age of rapid worldwide communication.

Not only is the importance of NFMs evident in accounting literature and the popular press, but managers are also confirming the importance of NFMs to support firm decisions. 57 of the top 100 U.S. companies are using NFMs in decision-making [Towers Perrin, 1996]. Moreover, managers feel that NFMs should be used more extensively and are very concerned with identifying appropriate performance measures [CMG, 1997; Consortium Benchmarking

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[9] Patricia Sturdevant of the National Association of Consumer Advocates calls the Internet a "weapon for the consumer...[because] before the Internet, unless you had a lot of time or money, there wasn't any way to get the public's attention to a problem. Now, you can broadcast it to the entire world in an instant" [Beck, 1999].

Study, 1997; Foster and Young, 1997].[10] In addition, the following statement of an anonymous division manager highlights the importance of NFMs in the company's future:

> "In the past, if you had lost my strategic planning document on an airplane and a competitor found it, I would have been angry but I would have gotten over it. In reality, it wouldn't have been that big of a loss. Or if I had left my monthly operating review somewhere and a competitor obtained a copy, I would have been upset, but, again, it wouldn't have been that big a deal. This Balanced Scorecard, however, communicates my strategy so well, that a competitor seeing this would be able to block the strategy and cause it to become ineffective" [Kaplan and Norton, 1994, p. 18].

The importance of NFMs is corroborated by the Special Committee on Financial Reporting (the Jenkins Committee), founded in 1991 by the American Institute of Public Accountants to determine cost effective ways of enhancing business reporting to better meet users' informational needs. The Jenkins Committee recommended reporting of factors that create longer-term value, including NFMs, defined as:[11]

> "data about a company's key business processes...they relate to the quality of products or services, relative cost of activities and the time required to perform key activities such as new product development" [AICPA,1994, p. 27].

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[10] A 1997 survey of management accountants shows that 63 percent of the respondent's companies use NFMs, but more importantly, 87 percent of the respondents state that NFMs should be used more extensively [CMG, 1997].

[11] The basic recommendation of the Jenkins Committee is that external reporting reflect the same dimensions and information as internal reporting. I cite the report, not for its relevance to external reporting, but rather its relevance for defining the importance of NFMs in internal decision-making.

In addition to recognizing the growing managerial role of NFMs, the Jenkins Committee supported its recommendation by stating that NFMs provide: leading indicators about a company's future, insight into the nature of a company's business as well as management's focus, perspective on sources of future cash flows unrecognized by the accounting model, and a longer term focus about the activities that build shareholder value and protect creditors [AICPA, 1994, p. 61].

2.3 EXTANT NFM RESEARCH

NFM research is in its infancy.[12] The link between NFMs, decision-making, and firm financial performance is just beginning to be examined using a variety of methods including surveys, analytic modeling, experiments, and statistics. The results have been mixed, creating a need for a better understanding of the cost-benefit relation of NFM usage. This section reviews extant literature in order to motivate this study by describing the current understanding of how NFMs affect firm decision-making and financial performance.

Prior NFM literature can generally be divided into two groups. The first group analyzes the relation between available NFMs and earnings, returns, and stock prices. The second group examines whether NFMs and FMs improve after firms incorporate NFMs into their incentive plans. The results of these studies are mixed, with some finding support for the proposed relation between NFM usage and (improved) financial performance, and others not finding support. This

[12] Shields' finding that there are very few articles on NFMs in the six leading management accounting journals between 1990-1996 supports this claim [Shields, 1997, p. 4].

literature is presented below, grouping studies according to either the Balanced Scorecard dimensions (customer, process, organizational learning), market strategy pursued by the firm, or NFM usage in incentive compensation plans.

2.3.1 Balanced Scorecard Dimensions

Several of these studies have investigated the impact of customer-oriented NFMs. In the wireless communications industry, financial information has little explanatory power, but the combination of financial information with customer-oriented NFMs has explanatory power for both stock prices and market-to-book ratios [Amir and Lev, 1996].[13] Similarly, Ittner and Larcker [1998a] find that announcements of firm-specific American Customer Satisfaction Indices are relevant to the market.[14] Several other studies find that customer satisfaction levels are positively associated with financial performance and predict changes in future financial performance [Anderson et al., 1994; Banker, Potter, and Srinivasan, 1998; Ittner and Larcker, 1998a].

A few studies, however, qualify the strength of the customer satisfaction – financial performance relation. Banker, Potter, and Srinivasan [1998] find that customer satisfaction is associated more with future financial performance than improvements in current financial performance. Ittner and Larcker [1998a] find that not only are there diminishing marginal returns for this relation, but large

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[13] Amir and Lev [1996] examine the following two NFMs: (1) the total population in a service area (POPS), which is an indicator of the growth potential, and (2) penetration rate, the ratio of subscribers to POPS, which is an indicator of operating and competitive success.

[14] The American Customer Satisfaction Index is a national economic indicator of customer satisfaction managed by the National Quality Research Center at the University of Michigan Business School and the American Society for Quality. The index is based on telephone survey responses from a nationwide random sample.

increases in customer satisfaction past certain "thresholds" are also necessary to improve financial performance. Moreover, Anderson, Fornell, and Rust [1997] report that manufacturing firms can simultaneously achieve high customer satisfaction and high productivity (ROI), but service firms that achieve high customer satisfaction must accept lower productivity. Finally, Foster and Gupta [1998] find higher customer satisfaction may lead to higher volume and gross profits (before service costs) but not to higher profitability, due to higher operating costs.

Other studies examine process, or production-oriented, NFMs. In the semiconductor industry, two papers look at the value of the book-to-bill ratio, an aggregate, industry-wide, monthly NFM.[15] The results show that the book-to-bill ratio is positively correlated with earnings changes in subsequent quarters, the market reacts to the release of the ratio, and that the inclusion of both earnings information and the NFM explains stock returns better than earnings alone. In addition, the book-to-bill ratio is a predictor of future changes in sales [Chandra, Procassini, and Waymire, 1996; Fargher, Gorman, and Wilkins, 1998]. On the other hand, case studies examining the adoption of Total Quality Management programs at Analog Devices and Sterling Chemical find that although quality levels increased, earnings and stock prices both decreased [Kaplan, 1990; Wruck and Jensen, 1994].

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[15] The book-to-bill ratio is a three-month moving average of new orders to shipments, generally considered to be a leading indicator of future earnings in the semiconductor industry. The ratio is prepared by the Semiconductor Industry Association, a trade association whose members voluntarily provide monthly order and shipment information to the society.

Regarding the organizational learning dimension of the Balanced Scorecard, several studies examine the impact of human resource management (HRM) practices. Generally, sophisticated HRM practices lead to lower turnover, higher productivity (sales/employee), and improved (real and perceived) financial performance [Huselid, 1994; Delaney and Huselid, 1996].[16] In addition, another study breaks HRM into two effectiveness components, strategic and technical, finding that strategic (technical) HRM effectiveness is (is not) associated with firm financial performance [Huselid, Jackson, and Schuler, 1997].[17]

Several case studies take a more comprehensive approach, examining multiple Balanced Scorecard dimensions. The first study investigates whether NFMs are leading indicators of profitability. Specifically, Nagar [1998] examines NFMs in the banking industry and reports that disaggregated FMs explain most of the variation in future earnings, but customer, employee and process NFMs add explanatory power. The remainder of the studies examines whether the ***use*** of multiple NFMs affects future performance.

For example, Rucci, Kirn, and Quinn [1998] find that when a major retail chain implemented a business model stressing employee satisfaction and customer satisfaction, there were dramatic improvements in these NFMs as well

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[16] Sophisticated HRM practices include the best practices in the areas of personnel selection, performance appraisal, compensation, grievance procedures, information sharing, attitude assessment, and labor-management participation [Huselid, 1994].

[17] Strategic HRM effectiveness is the perception of how well the HRM function facilitates teamwork, communications, involvement among employees as well as enhancing quality and developing needed talents for the future. Technical HRM effectiveness is the perception of how well the HRM function performs the traditional activities of personnel management (hiring, training, etc.) and compensation [Huselid, Jackson, and Schuler, 1997].

as revenues.[18] On the other hand, only 1 of 4 electrical and electronics firms saw profitability improving due to the use of NFMs [Kalagnanam and Krueger, 1998a]. Furthermore, AT&T abandoned employee and customer NFMs (as well as the use of EVA®) as key performance measures in favor of three traditional financial accounting measures (earnings growth, revenue growth, and SG&A expense reduction) because total shareholder return was –6.46 percent during a three year period [Ittner and Larcker, 1997].[19] Similarly, during the five quarters after adopting the Balanced Scorecard, Citicorp reported an increase in expenses and a decrease in both margins and return on sales [Ittner, Larcker, and Meyer, 1999].[20]

2.3.2 Market Strategy

The remaining NFM studies examine the impact of firm specific characteristics on the NFM usage – financial performance relation. Some of these studies examine the impact of a firm's overall market strategy, prospector or defender. Defender firms focus on a stable set of products and services that can be efficiently produced and distributed. Prospectors, on the other hand, are constantly developing new products and services and looking for new market opportunities [Miles and Snow, 1978].

A firm's strategy influences the type of information it uses to make decisions – broad scope or narrow scope. Broad scope information includes

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[18] Employee satisfaction increased by four percent, customer satisfaction by four percent, and revenues by 200 million in twelve months [Rucci, Kim, and Quinn, 1998].
[19] AT&T's competitors reported healthy returns for the same period: 16.44 percent for MCI and 112.46 percent for Sprint [Ittner and Larcker, 1997].
[20] Note that satisfaction, growth, and branch quality scores did increase [Ittner, Larcker, and Meyer, 1999].

future-oriented information, NFMs, and economic and non-economic information about the external environment [Chenhall and Morris, 1986]. Narrow scope information has a historic orientation, and focuses on financial accounting information and the internal environment [Gordon and Miller, 1976; Gordon and Narayanan, 1984; Chenhall and Morris, 1986]. Firms pursuing a prospector strategy are more likely to use broad scope information while firms pursuing a defender strategy are more likely to use narrow scope information [Gordon and Narayanan, 1984; Govindarajan and Gupta, 1985; Govindarajan, 1988]. Moreover, broad scope information usage has a greater (positive) effect on the performance of prospector firms than defender firms [Abernethy and Guthrie, 1994].

Other studies examine firms implementing a flexible (customer-focused) manufacturing strategy, which attempts to respond to customer demands by providing customized products and focusing on cost, quality, flexibility, and dependability. Firms following this strategy de-emphasize the use of traditional (efficiency focused) accounting measures and emphasize operations-based customer NFMs (e.g., customer complaints, on-time delivery, order to delivery time) in their performance measurement systems [Abernathy and Lillis, 1995; Perara, Harrison, and Poole, 1997]. Despite the emphasis on NFMs, the link between NFM usage and increased financial performance is not supported for flexible manufacturing firms [Perara, Harrison, and Poole, 1997].

2.3.3 Incentive Compensation Plans

The last stream of research examines NFM usage in incentive schemes and compensation plans. The initial studies in this area are principal-agent studies, which analytically examine the impact of incorporating NFMs into employee incentive schemes. Assuming NFMs are indicators of long-term focused employee effort, several studies find that incorporating NFMs into an incentive contract reduces employees' myopic behavior and increases long-term profitability [Hauser, Simester, and Wernerfelt, 1994; Hemmer, 1996; Dikolli, 1998]. To maximize firm profitability, the principal must place the appropriate incentive weight on the NFM and FM components. The incentive weights are determined by a variety of factors, including the type of NFM measure used (average or numerical), contribution margin, agent's discount factor, NFM precision, and uncertainty of the future sales estimates [Hemmer, 1996; Dikolli, 1998].

These studies also offer some insights into how to best incorporate NFMs into incentive contracts. For example, NFMs, specifically customer satisfaction measures, are more effective and profitable if separate satisfaction measures are developed for (1) each employee and (2) different classes of customers (e.g., current, non-current, competitor, level of switching cost) [Hauser, Simester, and Wernerfelt, 1994]. Unfortunately, translating many of the analytical results into practice is a difficult, if not impossible, task because many of the variables are hard and/or costly to capture (i.e., agent's discount factor, NFM precision, uncertainty, switching costs).

Empirical studies of incentive contracts find that an increasing number of firms are using NFMs as well as financial performance measures in annual bonus contracts. In 1994, 47/26 percent of the top Fortune 50 industrial and service firms used NFMs in their short-term/long-term incentive plan [SCA Consulting, 1994].[21] Incorporating NFMs into reward systems increases the proportion of NFMs included in the decision-making information mix [Morrissette, 1998]. Moreover, the relative weight placed on NFMs in bonus contracts is higher for prospector firms than defender firms. There is also some evidence that as the exogenous noise in the FMs increases (providing less information about the manager's actions), firms increasingly turn to NFMs to evaluate and reward performance [Ittner, Larcker, and Rajan, 1997].

Unlike the results of analytic studies (which support NFMs improving financial performance), the empirical evidence of the relationship between the incorporation of NFMs into bonus contracts and improved financial performance is mixed. Two studies find that after the implementation of a bonus plan incorporating NFMs, NFMs as well as financial performance measures increase [Banker, Potter, and Srinivasan, 1998; Rucci, Kirn, and Quinn, 1998]. Another study finds that NFMs improve but financial performance decreases [Ittner, Larcker, and Meyer, 1999].

Several possible reasons explain the mixed results of the empirical studies described above. The studies may omit critical variables affecting NFM usage. For example, the studies ignore the firm's level of perceived uncertainty. Broad

[21] Ittner, Larcker, and Rajan [1997] report that 36 percent of their (317 firm) sample use NFMs in their incentive contracts.

scope information, including NFMs, enhances decision-making and task performance when there is (perceived) high uncertainty [Mia and Chenhall, 1994; Chong, 1996]. When there is (perceived) low uncertainty, however, broad scope information usage causes information overload, which is damaging to decision-making and task performance [Chong, 1996; Gul and Chia, 1994].

Second, the studies do not evaluate how the information is presented to managers. Ignoring presentation may explain the mixed results because the format and organization of NFMs affect how effectively users incorporate NFMs into decision-making. Explicitly presented NFMs improve (capital allocation) decisions even when comparable information can be determined from the financial statements [Dietrich, Kachelmeier, Kleinmuntz, and Linsmeier, 1997]. Moreover, organization of NFMs along the Balanced Scorecard dimensions allows decision-makers to process higher volumes of information than without the framework. In addition, managerial evaluations are different when NFMs are organized in the Balanced Scorecard format than when presented in a list (the Balanced Scorecard allows them to "chunk" or process/evaluate performance by categories) [Lipe and Salterio, 1998].[22] Thus, to assist decision-making, NFMs must be readily-available and organized into categories relevant to firm performance.

The negative results of the NFM studies may also be attributed to how firms use NFMs. Firms may not be tracking the right number or types of NFMs. For example, a survey of the electrical and electronics industry finds that, on

[22] Lipe and Salterio also show that users focus on common NFMs, ignoring unique NFMs, when evaluating managers in different divisions [Lipe and Salterio, 1998].

average, firms report 2 NFMs on 5 dimensions, but focus mainly on one dimension - internal processes, which has 3 (9) times the number of measures compared to the customer (learning and growth) dimension. In addition, only 21.4 percent of these firms report customer satisfaction measures to plant managers. Because NFMs are timely indicators of future income, one would expect NFMs to be more important in short-term decision-making. However, 53 percent of these firms view FMs and NFMs as equivalent in importance for both long-term and short-term decision-making [Kalagnanam and Krueger, 1998b].

In addition, firms may not be consistently using NFMs in decision-making. Functional area membership influences the proportion of NFMs and FMs used in decision-making [Mia and Chenhall, 1994; Morrissette, 1998]. Many firms may collect NFMs, but few firms incorporate the measures into the budgeting process, lending additional support that firms may be tracking NFMs but are not completely integrating them into the decision process [Stivers et al., 1998].

2.4 CURRENT STUDY

Given that NFMs are leading indicators of future financial performance, integrating NFMs into the decision process should generate higher profits than basing decisions on FMs alone. However, empirical studies report conflicting results as to whether NFM usage improves financial performance. The mixed results may be attributed to many factors including research design limitations, preventing the detection of the benefits generated by NFM usage. Or, NFM usage

may actually not be beneficial due to the method in which managers incorporate NFMs into decisions and/or the firm's operating environment. To help understand when NFM usage improves firm performance, this paper investigates how these factors change the cost-benefits of using NFMs.[23]

The cost-benefit relation of using NFMs is predicted to vary as time progresses. Most empirical studies, however, are unable to capture the changes because they are restricted to a limited set of data (e.g., one or two years of ***annual*** data). For example, Foster and Gupta [1998] are limited to two years of annual data and state that their finding (that increased customer satisfaction does not improve profitability) may be due to this limited timeframe. Thus, a longer time series of data may be necessary to see how the costs and benefits of using NFMs evolve over time. This study extends existing literature by examining the costs and benefits of NFM usage over an extended period of time.

While managers may incorporate NFMs into decision-making in many different ways, this study focuses on the incremental benefits of measuring NFMs on a more frequent basis. The importance of measurement frequency is often ignored in accounting research and in the business world. As mentioned in Section 2.3, most empirical NFMs studies use 1 or 2 years of annual NFM and FM data. This design assumes that firms measure NFMs only once a year – a supposition corroborated by "real world" anecdotal evidence.[24]

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[23] Ittner and Larcker [1998b, p. 223-224] state that "an important research topic is identifying the circumstances under which [NFMs] do improve performance."

[24] At a Balanced Scorecard conference in the fall of 1998, several firm representatives stated that their companies measured NFMs once a year and therefore used the Balanced Scorecard for decision-making only on an annual basis.

Using NFMs less frequently to make decisions should reduce the benefits of using NFMs. More frequently collected NFMs should be more useful for decision-making than untimely NFMs because they allow managers to make necessary adjustments to operations sooner. Therefore, increasing the NFM measurement frequency should increase the benefits of using NFMs. This study extends extant literature by comparing the relative benefits of different measurement frequencies.[25]

Finally, this study examines on three conditions that may affect the operational and financial benefits of using NFMs in managerial decision-making. The three conditions capture the underlying temporal, measurement, and market conditions that firms are confronted with and that are inherent in every business model. The first condition, Time-Lag, depicts the length of time it may take for changes in NFMs to affect FMs. The second condition, NFM Measurement Error, captures the inherent, reliability – relevance trade-off of NFMs. The third condition, Demand Volatility, represents the level of uncertainty regarding the unit demand for the period. This study extends extant literature by assessing relative benefits of NFM usage as these three operating environment conditions change. The next three sections discuss these conditions in detail.

[25] NFM measurement frequency is presented separately from the following operating conditions for two reasons. First, managers control how frequently NFMs are included in decision-making, but managers do not (completely) control the three conditions listed below. Second, as outlined in Chapter 3, NFM measurement frequency is implemented differently from the three conditions.

2.5 TIME-LAG

The first condition, Time-Lag, captures the time relational aspect of NFMs and FMs. More precisely, it is the length of time that it takes for changes in one non-financial factor (or true, error free NFM) to affect other non-financial factors and/or financial factors. For example, Time-Lag is the number of periods that it takes for improvements in employee satisfaction to (positively) affect customer satisfaction.

Currently there "is no formal theory that indicates the specific number of lags for non-financial measures" [Banker, Potter, and Srinivasan, 1998, p. 19]. In addition, Foster and Gupta [1998] state that their finding that increased customer satisfaction does not improve profitability may be due to not identifying the appropriate time relation between the costs and benefits of NFMs. Moreover, most American companies do not pay enough attention to NFMs because they may lead future revenues and profits by more than one year [Thurm, 2000]. This study extends extant literature by comparing the relative benefits of NFM usage associated with different time-lags.

Not only are NFMs timelier and less aggregated than traditional financial numbers, as well as leading indicators of financial numbers, but they also help identify underlying operational problems [Kalagnanam and Kreuger, 1998a]. Decision-makers want (and need) this type of forward-looking information as soon as possible in order to correct underlying problems and optimize results. The longer a problem goes uncorrected, the longer profits are reduced. This is especially true when changes in operations do not affect profits immediately.

Therefore, the longer the time-lag between changes in non-financial factors (or true, error free NFMs) and the subsequent financial performance, the higher the expected benefits, because NFMs allow managers to identify and correct problems sooner than do FMs alone.

The next section discusses the second condition, NFM Measurement Error, which may also affect the benefits of incorporating NFMs into managerial decision-making.

2.6 NFM MEASUREMENT ERROR

The second condition that may affect the benefits of NFM usage in decision-making is the accuracy of the NFMs, or NFM Measurement Error. This component is based on the concepts outlined in Statement of Financial Accounting Concepts 2, which identifies the two primary qualities that make accounting information instrumental to users (i.e., decision-makers). The first quality is relevance. "Accounting information is relevant if it has the capacity to make a difference in a decision" [Delaney, 1998, p. 586]. To be relevant, information must possess predictive value, feedback value, and timeliness. Thus, relevant information helps users make predictions about the future profitability of a firm. The second quality is reliability. Accounting information is "reliable if it is reasonably free from error and bias, and faithfully represents what it claims to represent" [Delaney, 1998, p. 586]. To be useful, accounting information must be both reliable and relevant. Consequently, even though many forms of information

may be highly relevant, only reliable information should be used for decision-making.

Section 2.2 describes NFMs as: (1) leading indicators of future financial performance; (2) more timely than financial numbers; and (3) encouraging double-loop learning (understanding the cause-and-effect relation between actions and outcomes). These characteristics fulfill the requirements of predictive value, timeliness, and feedback value, respectively. However, NFMs include "softer" items such as satisfaction that are hard to capture and measure precisely, and therefore NFMs may contain measurement error and may not always be reliable [Rucci, Kirn and Quinn, 1998]. The condition, NFM Measurement Error, captures this inherent reliability-relevance trade-off because NFM Measurement Error is the level of imprecision or noise contained in the NFMs.

Measurement error should reduce the benefits associated with NFM usage because as the measurement error of NFMs increases, managers are basing decisions on (increasingly) imprecise information and are more likely to make decisions that may adversely affect the firm. In fact, decisions based on inaccurate NFMs may be worse than decisions based on FMs only, even without considering the extra cost of measuring the NFMs. Moreover, managers may be less willing to rely on the NFMs, if they know they contain measurement error.

The next section discusses the third condition, Demand Volatility, which may also affect the benefits of incorporating NFMs into managerial decision-making.

2.7 DEMAND VOLATILITY

The third condition, Demand Volatility, represents the market conditions faced by the firm. Most firms are facing a rapidly changing marketplace in terms of products, consumer preferences, and competition. The market represents an uncertainty that may affect operations and financial results. Extant literature suggests that when there are high levels of perceived environmental uncertainty, timely NFMs are perceived as more important and NFM usage increases managerial performance [Gordon and Narayanan, 1984; Chenhall and Morris, 1986; Gul and Chia, 1994; Mia and Chenhall, 1994; Chong, 1996; Chong and Chong, 1997]. When environmental uncertainty is high, incorporating NFMs into decision-making should help managers react quickly (and appropriately) to changes in the environment because NFMs help pinpoint problems in a timely manner. Therefore, Demand Volatility should increase the benefits of using NFMs.

2.8 THE EMPLOYEE-CUSTOMER-PROFIT CHAIN

A business process model is necessary to study the three conditions described above in Sections 2.5, 2.6, and 2.7. This study implements a specific type of enterprise relationship management, the service-profit chain or the Employee-Customer-Profit chain (ECP). This ECP model is based on the underlying premises of the "Loyalty Effect" which assumes that there is a chain of cause-and-effect running from employee satisfaction to customer satisfaction to profits [Reichheld and Teal, 1996]. In particular, employee satisfaction drives the

service level provided to customers; the service level drives customer satisfaction; and finally customer satisfaction drives profitability.

Many service firms, including Federal Express, Sears, Southwest Airlines, Ritz-Carlton, and USAA, use the ECP chain in strategy formulation and subsequent performance evaluation [Heskett, Sasser, and Schlesinger, 1997]. These service firms sell "experience" goods.[26] Unlike "search" goods that customers can evaluate before the purchase based on price or product feature differentiation, customers evaluate "experience" goods based on the level of service provided at the time of purchase [Anderson and Sullivan, 1993]. Therefore, firms selling an "experience" good must provide high levels of customer service to maximize firm profitability. While the ECP model can be used for any type of firm, the business model is ideally suited for service firms because the ECP model helps managers maximize employee satisfaction, customer satisfaction, and ultimately firm profitability.

The ECP model asserts that to maintain high employee satisfaction levels, employers should compensate employees well, create a positive working environment, and provide continuous employment even during economic downturns. If efforts are not made to keep employee satisfaction high, employee satisfaction decays. To prevent this decay, identified deficiencies are corrected by providing employees with additional support in the form of training, improved working conditions, bonuses, and needed resources (e.g., equipment, information)

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[26] While Sears does sell search goods (e.g., electronics and clothes), it also sells a shopping experience, which customers evaluate based on multiple dimensions including store appearance and the helpfulness of employees.

– all designed to enhance employee learning and align employees' interests with those of the firm [Denton, 1992; Dignall, 1993]. Satisfied employees are expected to reward the firm with higher levels of loyalty and lower levels of turnover (reducing hiring, firing, and training costs).[27] Moreover, satisfied employees provide better customer service because they are more productive, more knowledgeable about the firm's products and services, and can build a long-term relationship with the customer.

Because satisfied employees provide better customer service, customer satisfaction increases. Long-tenured employees can build lasting relationships increasing the value of the product delivered to the customer. This creates satisfied customers that remain with the firm for longer periods of time, reducing customer acquisition costs. Satisfied customers recommend the firm to other potential customers and their purchases are likely to increase over time.[28] Thus, satisfied customers reduce customer turnover, which averages 10 to 30 percent each year, and increase customer retention rates [Reichheld and Teal, 1996]. An increase in customer retention can have a dramatic affect on profits – a 5 percent increase in customer retention can increase profits by 20 percent [Reichheld and Teal, 1996]. Thus, improving employee satisfaction and customer satisfaction can reward the last constituent, investors, with higher financial results [Schneider and Bowen, 1995; Reichheld and Teal, 1996; Heskett et al., 1997].

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[27] A survey reveals that eighty percent of highly satisfied employees intend to stay with their firm more than two years compared to twenty percent of dissatisfied employees [Business Research Lab, 1999].

[28] Note that customer loyalty can be viewed as a continuum between price-sensitive/non-loyal and loyal customers. Because loyal customers can be either profitable of unprofitable, the firm should only focus on the profitable segments [Reichheld and Teal, 1996].

The ECP model is selected because it is based on a well-developed theory, contains multiple NFMs that drive FMs, is supported by "real world" financial successes, and allows the three conditions to be studied individually and jointly. Moreover, several organizational research studies find that an employee's satisfaction with his/her job is positively correlated to both job commitment and job involvement.[29] Furthermore, job commitment is positively related to an employee's intent to stay and negatively related to turnover [Morrow, 1993]. These studies support the underlying premise of the ECP model – satisfied employees are more loyal to the firm and will work hard at providing better customer service.

In the current business environment, firms must contend with decreasing employment tenure, increasing hiring and training costs, and increasing service demands from customers, who are now the principal source of economic authority [Baum, 1999; Petzinger, 1999; Weaver, 1999]. More firms are monitoring employee and customer satisfaction in an attempt to attract and retain employees and customers as business competition changes [Baum, 1999; HR Focus, 1999; Zornes, 1999]. These firms will require a business model, like ECP, to help them manage employee satisfaction and customer satisfaction. Moreover, the results of this study should help managers understand the costs and benefits of NFM usage.

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[29] Job commitment is the extent to which an employee feels connected to his/her job. Job involvement is the degree of absorption that an individual has towards his/her work activity [Morrow, 1993].

2.9 SUMMARY OF STUDIED CONDITIONS

The results of empirical studies may be affected by their research design. Specifically, the use of short time windows may cause empirical studies to incorrectly conclude that NFM usage does not improve financial performance.[30] This study attempts to overcome this limitation by examining NFM usage over a long time horizon.

NFM measurement frequency as well as other variables in the firm's operating environment may affect the benefits of using NFMs. While many such variables may affect the results of empirical studies, this study focuses on three specific variables, Time-Lag, NFM Measurement Error and Demand Volatility. Accordingly, this study explores how changes in these conditions affect the benefits of NFM usage over time. Specifically, I examine the impact of different time-lags between non-financial factors (or true, error free NFMs) and FMs. I also manipulate the level of NFM Measurement Error. In addition, I study the impact of one type of environmental uncertainty that a firm may encounter - the volatility of the market's demand for products.

The following chapter, Chapter 3, outlines the operationalization of the ECP business model and the studied conditions, Time-Lag, NFM Measurement Error, and Demand Volatility. The chapter also describes how the study captures the cost-benefit relation generated by NFM usage over time and examines the following questions:

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[30] The improper specification of the NFM-FM Time-Lag may also affect the results of empirical studies.

- How does NFM measurement frequency affect the cost-benefit relation?
- How does increasing the Time-Lag between changes in non-financial factors and financial performance affect the cost-benefit relation?
- How does NFM Measurement Error affect the cost-benefit relation?
- How does Demand Volatility affect the cost-benefit relation?

Chapter 3: Research Design

3.1 OVERVIEW

This study's main objective is to determine the costs and benefits of incorporating NFMs into managerial decision-making. To accomplish this goal, the study examines the pattern of the costs and benefits over an extended period of time. The study also investigates how the pattern changes when NFMs are used with varying frequencies in decision-making. Finally, the study examines how three conditions, Time-Lag, NFM Measurement Error, and Demand Volatility, affect the costs and benefits of incorporating NFMs into managerial decision-making.

The first condition examines the temporal relation between NFMs and profits, expecting that the value of integrating NFMs into decision-making increases as the time-lag between changes in non-financial factors and subsequent changes in other non-financial and/or financial factors grows longer. The second condition addresses the effect of measurement error, predicting that the value of integrating NFMs into decision-making decreases as measurement error increases. The third condition addresses the effect of market uncertainty, or demand volatility, predicting that the value of integrating NFMs into decision-making increases as demand volatility increases. No predictions are made for the interactions.

The next section describes the methodology and business process model used to examine the three conditions. Major subsections provide details of the

methodology and design, including the underlying model, the dependent and independent variables, and procedure. Rationale for the selected methodology, simulation, is then outlined. The chapter concludes with a comparison of the current study with prior accounting studies of NFMs.

3.2 METHOD

3.2.1 System Dynamics[31]

A system dynamics approach is employed to study the impact of NFMs on decision-making. At the most simplistic level, system dynamics is the ability to see the world as a complex system where everything is connected to everything else [Sterman, 1994]. As a research paradigm, system dynamics is used to investigate the information-feedback character of organizational systems in order to understand the complexity of an organization, improve operating policies, and assist with organizational learning [Forrester, 1961; Sterman, 1994]. Thus, the goal of system dynamics is to improve managerial effectiveness and firm performance by understanding the behavior of the organization for a given policy. In this case, the policy is the use of NFMs. A brief description of the paradigm follows.

System dynamics examines the dynamic behavior of an organization over time. The paradigm begins with the development of a simplified, but realistic, model of organizational processes. This model has several important

[31] The description of system dynamics is based on the writings of Forrester (1961), Sterman (1994), Richmond and Peterson (2000), and Sterman (2000).

characteristics. First, the model specifies the structural relationships, describing how "the conditions at one point in time lead to subsequent conditions at later points in time" [Forrester, 1961, p. 17]. Second, the model integrates not only functional areas but also external constituents to reflect the interdependent nature of a firm's internal operations and external environment.

Third, the model incorporates feedback loops, or circular/closed-loop causal relationships, reflecting that all decisions take place in the context of feedback loops. Specifically, the firm's operating environment affects managers' decisions, causing actions that affect the environment and ultimately influence future managerial decisions. Finally, the focus of the model is the underlying relationships, not the specific numbers used in or generated by the model. The focus is on the relationships because precise data rarely exists and the model is built using all available data including non-numerical data and reasonable estimates.

Once the model has been specified, an analysis of the system is performed using computer simulation. The computer simulation compresses both time and space, allowing the dynamics of the model to be studied over an extended period of time as selected conditions change. Simulation also allows alternative decisions and actions to be compared in order to determine the best operating policies. The next section provides a high level description of the business process model that is examined using this system dynamics paradigm.

3.2.2 High-Level Overview of the Implemented ECP Model

To study the impact of integrating NFMs into managerial decision-making, a model of a firm's business and decision processes for a given production function is needed. This paper implements a simplified form of the ECP model described in Section 2.8 of chapter 2. As in any modeling exercise, several simplifying assumptions have been made about the market, compensation, employees, and the relation between customer satisfaction and employee satisfaction. This section provides a high-level overview of the assumptions used to implement the ECP model, while Section 3.2.4 presents a detailed description of the system dynamics ECP model.

Figure 1 presents a high-level schematic of the implemented ECP model for a firm selling an "experience" good. The starting point of the model is the human resources - employee satisfaction relation. To maintain high levels of employee satisfaction, the human resource department provides employees with needed support or Employee Support Measures (e.g., training, bonuses, equipment) and incurs a cost, denoted as Employee Support Expenditures, which the business measurement system collects and stores.[32] Providing Employee Support Measures is the only method available for increasing employee satisfaction in this model. In addition, the level of employee satisfaction affects the productivity of employees as well as the level of employee turnover during the period. Specifically, employee satisfaction is positively related to employee productivity but negatively related to employee turnover.

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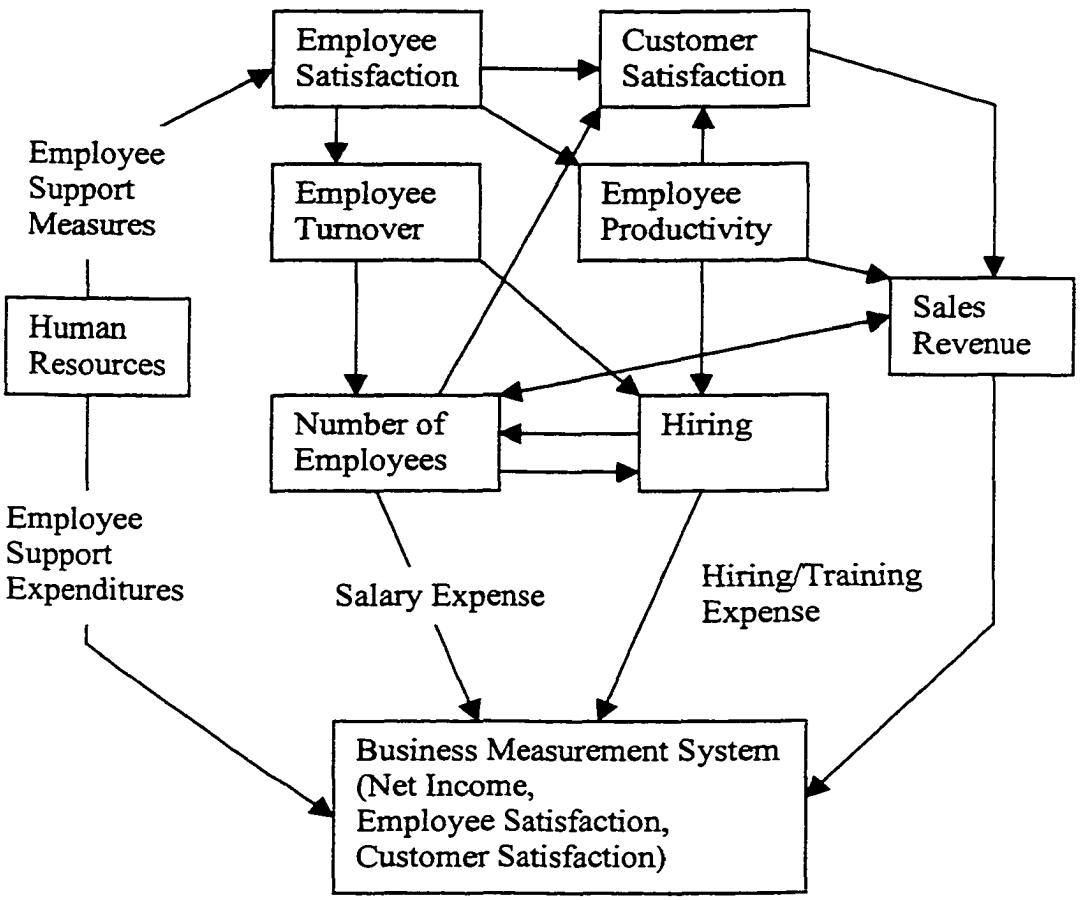
[32] These Employee Support Expenditures should have a positive effect on the working environment and the employee satisfaction level [Gerhart, 1990].

Figure 1: Implemented Employee-Customer-Profit Chain Model - Overview



Regarding the Employee Support Expenditures, I assume that the firm implements 1 of 3 Employee Support Expenditures levels each period – levels 1, 2, and 3. Each successive level leads to a greater effect on employee satisfaction and higher cost, because investments needed to improve service quality increase exponentially at high quality levels [Ittner and Larcker, 1998a, p. 3]. Section 3.2.3 discusses the decision frameworks determining the appropriate Employee Support Expenditure level.

The next link in the ECP model is between employee satisfaction and customer satisfaction. Because the level of employee satisfaction determines the level of service quality in the ECP model, this study uses employee satisfaction as a proxy for service quality [Tompkins, 1993; O'Malley, 1997]. In addition, the firm in this model sells an "experience" good, making advertising and marketing programs (relatively) ineffective with respect to customer satisfaction. Thus, in this abstracted setting, increasing employee satisfaction is the only way to increase customer satisfaction. If employee satisfaction does not remain high, customer satisfaction declines.

The next link in the ECP model is between customer satisfaction and sales revenue. If customer satisfaction is high, customers reward the firm with lower customer turnover, increased purchases, and positive word-of-mouth advertising. If customer satisfaction is low, customers penalize the firm with higher customer turnover, decreased purchases, and negative word-of-mouth advertising.

The sales revenue level affects the number of employees and the salary expense. The firm hires additional employees when demand significantly

increases, but in accordance with the ECP philosophy does not layoff employees when sales demand decreases. The firm incurs a hiring/training cost for each new employee. Moreover, the employee productivity level and the number of employees determine the number of services that can be provided to customers during the period. Finally, the implemented model holds all prices and costs other than salary expense, hiring costs, and Employee Support Expenditures constant, making net income a function of sales revenue, salary expense, hiring/training expense, and Employee Support Expenditures. Thus, net income is essentially a cash net income.

Several other assumptions about the market and employees are made. Regarding the market in which the firm operates, there is no price or product differentiation. Firms must compete with the level of service they provide to customers. This assumption allows the impact of price changes on demand to be disregarded and also allows customer satisfaction to have a strong effect on the demand. By assuming no inflation, constant wage rates and prices are possible. Regarding employees, learning curve effects on productivity are ignored in order to focus on the essential elements of the research questions. Finally, the compensation rate has been set equal to the rate of a firm using the ECP philosophy. Table 1 presents a summary of the assumptions used to implement the ECP model, while the next section outlines the three decision frameworks used to determine the appropriate level of Employee Support Expenditures.

Table 1: ECP Model High Level Assumptions

Market

1. No price or product differentiation among the competitors.
2. Firms compete on the level of service they provide.
3. No inflation.

Employee

1. No learning curve effects.
2. Compensation is set at a fixed amount per employee.
3. Employee satisfaction decays each period at a fixed rate.
4. Employee Support Measures increase satisfaction, are implemented every period, and have an associated cost, Employee Support Expenditures. More Measures (with higher Expenditures) are implemented when employee satisfaction declines.

Customer

1. Advertising does not affect customer satisfaction or customer demand.
2. Customer satisfaction can only be increased by increasing employee satisfaction.
3. Customer satisfaction decays at a constant rate each period.
4. Demand is increased or decreased according to the level of customer satisfaction.

3.2.3 Design

Independent Variables

To examine the system described above, a simulation of the ECP model is conducted for three conditions and three decision frameworks using the design presented in Figure 2. The conditions characterize the operating environment of the firm and include Time-Lag, NFM Measurement Error, and Demand Volatility. The three decision frameworks (No NFM, Always NFM, and Intermittent NFM) operationalize NFM measurement frequency by incorporating NFMs into decision-making in varying frequencies. The decision frameworks and conditions are discussed below.

Figure 2: Design[33]

	Condition		
	Time-Lag	NFM ME	DV
Decision Framework	(0/1)	(None/High)	(None/High)
No NFM			
Intermittent NFM			
Always NFM			

[33] ME and DV refer to Measurement Error and Demand Volatility, respectively.

Decision Framework

To maximize net income, the manager has three possible action choices at the beginning of each period: implement level 1 Expenditures, implement level 2 Expenditures, or implement level 3 Expenditures. Determining the appropriate level of Employee Support Expenditures requires managers to first collect and analyze relevant information, and then decide on the appropriate course of action. Due to limited information processing capabilities, managers are likely to develop simple, standardized decision rules that only use a subset of the (total) available information [March and Simon, 1958; Etzioni, 1989; Shoham, 1999]. Therefore, to simulate this real world "bounded rationality," the implemented decision frameworks use simple decision rules. The manager makes his/her decision based on the decision framework, which determines both the information set available for decision-making as well as the decision rule.

In order to determine the benefits of incorporating NFMs into the decision-making process, the ECP model must be simulated twice – one time for a firm using only FMs to make decisions and a second time for a firm using both NFMs and FMs consistently to make decisions (i.e., every period). Furthermore, to analyze the benefits of using NFMs, which are measured less frequently, the ECP model is simulated a third time for a firm that supplements FMs with NFMs, but not every period.

Three decision frameworks permit a comparison of the decisions and outcomes as conditions change simultaneously for each framework. The first decision framework, No NFM, represents a firm making decisions based only on

a traditional FM, net income. The second framework, Always NFM, represents a firm making decisions based on a FM, net income, as well as two NFMs, employee satisfaction and customer satisfaction, which are leading indicators of profitability. The third decision framework, Intermittent NFM, represents a firm making decisions based on a FM, net income, supplemented with NFMs, employee satisfaction and customer satisfaction, every fourth period.

Each decision framework has its own decision rules. While all three decision frameworks use FMs to make decisions every period, the decision frameworks represent a continuum of NFM usage in decision-making as depicted below in Figure 3.

Figure 3: NFM Usage Continuum

Decision Framework:	No NFM⇒	Intermittent NFM⇒	Always NFM
NFM Usage in Decisions:	None	Every 4th period	Every Period
FM Usage in Decisions:	Every Period	Every Period	Every Period

Specifically, in the No NFM decision framework, managers select the appropriate action (Expenditure level) based upon the prior period's net income levels. Thus, I am assuming that when profits drop, management investigates the reason for the reduction, is able to determine the cause (low employee satisfaction, low productivity, high employee turnover), and corrects the employee satisfaction problem by instigating the appropriate satisfaction measures to increase employee satisfaction.

In the Always NFM decision framework, managers first determine the appropriate Expenditure level for each measure (net income/employee satisfaction/customer satisfaction) based upon the prior period's measures. If a real firm were using NFMs (and/or a Balanced Scorecard) in decision-making, managers would integrate all three measures into the decision process. For this simulation, the three Expenditure levels are averaged (and rounded to the nearest integer) to select the appropriate action to implement, reflecting that managers are incorporating all relevant information into the decision process equally.[34]

The Intermittent NFM decision framework is a hybrid of the No NFM and Always NFM decision frameworks and represents a firm that uses NFMs for decision-making but does not measure NFMs frequently (e.g., firms using Balanced Scorecard on an annual basis). Therefore, this decision framework uses the No NFM decision rules to make decisions for 3 periods and the Always NFM decision rules to make decisions every fourth period. Figure 4 shows the feedback loops (dashed lines) for the decision rules in the implemented ECP model.

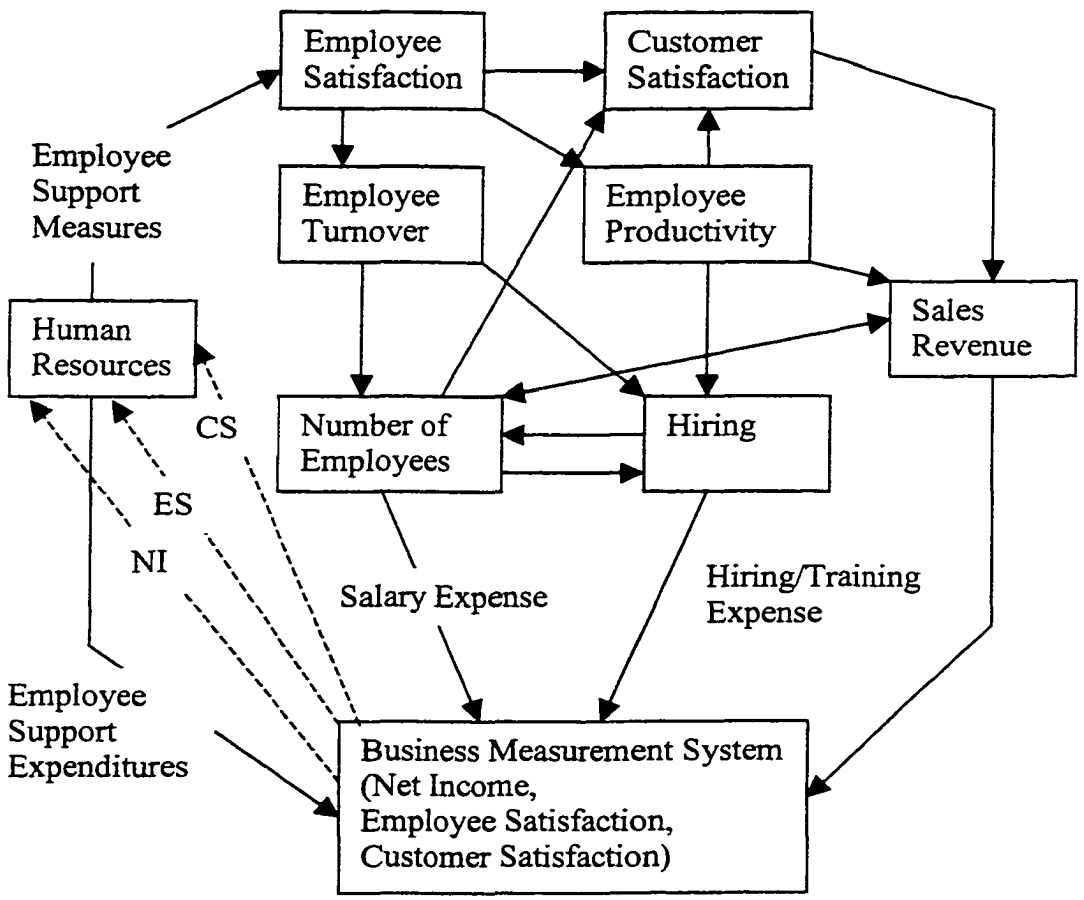
Time-Lag

Time-Lag is the structural (or temporal) relationship between NFMs and FMs. In this study, Time-Lag represents the length of time (in periods) that it takes for changes to traverse each link in the ECP chain (described in Section

[34] This method is equivalent to setting weights equal to one-third net income, one-third employee satisfaction, and one-third customer satisfaction. This weighting scheme is used to match the information mixture and weighting scheme used by Sears in its long-term executive incentive plan [Rucci, Kirn, and Quinn, 1999].

3.2.2 and in Figures 1 and 4). Specifically, Time-Lag is the length of time that it takes for Employee Support Expenditures to affect employee satisfaction, employee satisfaction to affect customer satisfaction, and the customer satisfaction to affect sales revenue/net income.

Figure 4: Implemented Employee-Customer-Profit Chain Model – Overview with Decision Feedback Loops[35]



[35] NI, ES, CS refer to net income, employee satisfaction, and customer satisfaction, respectively. The dashed lines identify the feedback loops.

Two Time-Lags are examined. The first length, zero periods, represents an ECP where Employee Support Expenditures affect employee satisfaction, customer satisfaction, and net income in the same period. The second length, one period, represents an ECP where each link has a length of 1 period. Specifically, employee satisfaction takes 1 period to fully reflect the impact of Employee Support Expenditures; customer satisfaction takes another period to fully reflect a change in employee satisfaction; and net income takes a third period to fully reflect the impact of customer satisfaction changes on demand.

NFM Measurement Error

NFM Measurement Error is the level of imprecision or noise contained in the NFMs. In this study, measurement error is manipulated for employee satisfaction and customer satisfaction. In the "real world," satisfaction is an underlying factor that is hard to capture and can be measured in many ways. The employee satisfaction and customer satisfaction measures represent the firm's attempt at capturing the underlying (true) satisfaction factors.

To simulate the imperfection of the satisfaction measures, two levels of measurement error are added to the satisfaction factors. The first level, zero, is defined as no measurement error, meaning that the satisfaction measures perfectly capture the underlying satisfaction factors. The second level, high, is defined as a random number selected from the distribution ~N(0, 25), making the observed satisfaction measure above or below the actual satisfaction factor. The errors are randomly selected from the appropriate range to simulate "real" satisfaction measures, and because a fixed error measure would represent a systematic bias

instead of a random, unknown measurement error. A different error is selected for each satisfaction measure to insure that the errors are independent.

Demand Volatility

Demand Volatility represents one external, uncontrollable uncertainty facing the firm. In this study, Demand Volatility refers to the level of uncertainty regarding the market's (unit) demand for the firm's products. Two levels of Demand Volatility are examined. The first level, zero, represents a level of expected demand that entirely based on the firm's customer satisfaction level. The second level, high, represents a level of expected demand that is very unpredictable each period. Specifically, the number of customers determined by the customer satisfaction level is adjusted each period by an amount equal to the prior period's number of customers times a random number selected from the distribution ~N(0, 0.0025).[36] Once again a random number, rather than a fixed number, is used to simulate the randomness of the "real" world.

Dependent Variables

Several dependent variables are used to quantify the differences between the No NFM, Intermittent NFM, and Always NFM decision frameworks. The first dependent variable, Cumulative Net Income Difference, focuses on a primary FM used by managers and the stock market to evaluate a firm. Net Income Difference is the difference between the Always NFM and No NFM net incomes during one period. The Cumulative Net Income Difference is the Net Income

[36] The +/- three standard deviation range is +/- fifteen percent.

Difference in the current period plus the sum of all prior Net Income Differences as shown by Equation 1A and indicates how much additional income could have been earned (or lost) by using NFMs to make decisions.

$$\text{Cumulative Net Income Difference}_{1,t} = (\text{Always NFM Net Income}_t - \text{No NFM Net Income}_t) + \text{Cumulative Net Income Difference}_{1,t-1} \quad (1A)$$

Cumulative Net Income Difference is also calculated for the Intermittent NFM decision framework. This Difference indicates how much additional net income the firm earns (or loses) if it uses NFMs in decision-making every fourth period. Equation 1B shows how this Difference is calculated.

$$\text{Cumulative Net Income Difference}_{2,t} = (\text{Intermittent Net Income}_t - \text{No NFM Net Income}_t) + \text{Cumulative Net Income Difference}_{2,t-1} \quad (1B)$$

The Cumulative Net Income Differences are used to determine the payback period, or the first period in which the Cumulative Net Income Difference is greater than zero. The payback period represents the number of periods that a firm must continue using NFMs before the financial performance of the firm exceeds that of a firm just using FMs for decision-making (No NFM decision framework).

To help understand the Cumulative Net Income Differences, the system tracks several other performance measures (separately) for the No NFM, Intermittent NFM, and Always NFM decision frameworks.[37] The system collects retained earnings, profit margins (sales divided by net income), customer growth, employee turnover, and the employee productivity level, which represents the number of units completed/delivered by each employee during the period.

Finally, the system attempts to estimate the value of employee satisfaction and customer satisfaction to the firm. Starting with employee satisfaction, Employee Asset Value measures the value of employees to the firm. Specifically, Employee Asset Value represents an unrecorded intangible asset and is based on the tenet that employees are assets to the firm because they generate future income based on their knowledge and relationships with customers. The variable is inspired by the statement that "the dollar profit that accrues to the company as a result of an individual's work provides the best estimate of his/her worth to the company" [Cascio (1982), p. 155]. The variable is calculated using Equation 2:

$$\text{Employee Asset Value}_t = (\text{profit/unit}_t)\,(\text{productivity}_t)\,\frac{\left(1-\frac{1}{(1+\partial)^{\varepsilon}}\right)}{\partial} \quad (2)$$

where:

Employee Asset Value$_t$ = current value of employee assets at time t

profit/unit$_t$ = average profit per unit delivered in period t

[37] Because this study is not using "real" data, the *absolute* levels of the dependent variables have little meaning. However, a comparison of the dependent variables across the decision frameworks gives us an understanding of how the decision frameworks perform *relative* to one another.

$productivity_t$ = average number of units produced by each employee in period t [0,15]

∂ = discount factor = 1 percent/period

t = time period

E = average number of periods an employee remains with the firm

= (1/turnover rate)

Employee Asset Value represents the net present value of the profit ($profit/unit_t$ times $productivity_t$) generated by an employee over the average length of time that he/she remains with the firm, represented by E.[38] Increasing employee satisfaction increases employee productivity and reduces employee turnover resulting in an increase in the Employee Asset Value. The average profit per unit also varies from period to period due to changing Employee Support Expenditures, hiring, and salary expenses.

Customer Asset Value measures the value of customers to the firm. Customer Asset Value represents an unrecorded intangible asset and is based on the tenet that customers are assets to the firm because they generate future net income through repurchases. Customer Asset Value is the present value of these future purchases. Higher levels of customer satisfaction increase customer repurchases and therefore increase Customer Asset Value. Equation 3 shows how

[38] I use the formula for the present value of an annuity, rather than the present value of a single sum, because I assume that the employee will continue to produce the same level of revenue in each future period.

to calculate Customer Asset Value. The equation is a modified form of a formula developed by Anderson and Sullivan [1993] and Anderson et al. [1994].[39]

$$\text{Customer Asset Value}_t = (\text{profit/unit}_t)\,(0.0058)\,(CS_t)\,\frac{\left(1-\frac{1}{(1+\partial)^P}\right)}{\partial} \qquad (3)$$

where:

Customer Asset Value$_t$ = current value of customer assets at time t

profit/unit$_t$ = average profit per unit delivered in period t

0.0058 = incremental probability that a customer will repurchase from the firm, associated with a one-point unit increase in the customer satisfaction level (i.e., 78 to 79) [Anderson and Sullivan, 1993; and Anderson et al., 1994]

CS_t = customer satisfaction level in period t [0,100]

∂ = discount factor = 1 percent/period

t = time period

P = represents the timeframe over which the value of the purchases is measured = 20 periods

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[39] Anderson and Sullivan [1993] and Anderson et al. [1994] use the following formula:

$$CCA_t = \sum_{t=1}^{T} \lambda G(\Pr\{\text{Loyal}|\text{Satisfaction}\}/(1+\delta)^{t/\lambda}$$

where:
CCA_t = Current value of customer assets at time t
λ = length of average repurchase cycle
G = average gross margin per period
Pr{Loyal|Satisfaction} = probability that a satisfied customer will remain loyal
= 0.0058 (customer satisfaction level) = 0.0058 CS_t
δ = discount factor
t = time period in periods
I assume that the repurchase cycle (how often customers buy) equals one period.

The average profit per unit varies from period to period due to changing Employee Support Expenditures, hiring, and salary expenses. The product of 0.0058 and the customer satisfaction level (CS_t) represents the probability that a customer continues to repurchase from the firm at the current satisfaction level. P is (arbitrarily) set at 20 periods.[40] Table 2 summarizes the dependent variables.

Table 2: Dependent Variables

Measured at the End of the Simulation

1. Cumulative Net Income Difference$_1$: total difference between the Always NFM Net Income and the No NFM Net Income over the simulation
2. Cumulative Net Income Difference$_2$: total difference between the Intermittent NFM Net Income and the No NFM Net Income over the simulation
3. Retained Earnings: total net income generated over the simulation

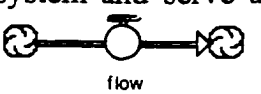
Measured Each Period

4. Profit Margin: the percent profit (net income/sales revenue) generated
5. Employee Asset Value: the estimated value of an employee to the firm
6. Customer Asset Value: the estimated value of a customer to the firm
7. Employee Productivity: number of units produced by one employee
8. Employee Turnover: the percent of employees quitting
9. Customer Growth: the percent increase in customers

[40] Anderson et al. [1994] use an arbitrary period of 5 years.

3.2.4 Detailed Model Definition

This subsection describes the detailed system dynamics model and methodology used to simulate the ECP business model for a service firm. The system dynamics model captures the ECP model described above and incorporates the studied conditions as well as "real world" random shocks that may inexplicably and unpredictably affect employee satisfaction and customer satisfaction.

Software, called *ithink* (version 6.0), is used to develop the system dynamics model.[41] *ithink* uses a series of structural elements (rectangles, pipes with arrowheads, circles, arrows, and clouds) to represent the model of the system. In order to understand the *ithink* model, each element is now described. The two main elements of the system are stocks and flows. Rectangles (□) represent stocks or accumulations in the system and exist even when activity is stopped. Stocks support the action in the system and serve as a barometer of current conditions. Pipes with arrowheads () represent flows. Flows directly change accumulations by transporting "stuff" into and out of stocks. The flow regulator (O) and spigot ( ) control the flow volume, based on the algebraic expression entered in the flow regulator. At the beginning and end of the pipe are clouds, which represent boundaries that are inconsequential to the system (i.e., no constraints on inputs or outputs).

[41] High Performance Systems, Inc. develops *ithink*.

While stocks and flows define the essence of the process, several additional elements are also used to define the system. Circles (O) represent converters. Converters perform many activities including breaking out detail logic and converting stocks into alternative, score-keeping variables, such as liquidity, inventory coverage, net income, etc. Unlike stocks, converters do not accumulate and are recalculated each period. Arrows (→) represent connectors linking the other components. Connectors are information feedback links, which transmit values from other building blocks. Connectors represent inputs and outputs, not inflows and outflows, and therefore cannot change stocks.

System dynamics terminology and symbols are used to develop the ECP model. For ease of exposition (and programming), the implemented ECP model is subdivided into 5 sectors. Four of these sectors capture the main components of the ECP model and correspond to the dimensions of the Balanced Scorecard: Learning and Growth, Customer, Process, and Financial. The remaining sector contains the decision-making logic for the three decision frameworks. Throughout the discussion, the relevant connectors, stocks, and flows are parenthetically identified to help identify portion of the model being described. To help understand the sectors, a brief description of the major numerical assumptions is first presented.

Numerical Assumptions

Due to the lack of firm specific data, many assumptions have been made to implement the ECP model, including assumptions about the values of the

variables as well as the relationship between variables. Numbers that make sense relative to one another, rather than precise numbers, are required to understand a business phenomenon [High Performance Systems, 1997, p.74]. To create this relative realism, the selected values and relations are based on an extensive search of relevant accounting, management, and marketing literature. For example, employee satisfaction and customer satisfaction have a range of 0 to 100. In addition, their initial values have been set at 75 because firms adopting the ECP model (want and) need to increase their satisfaction levels. Similarly, the initial values of the Employee and Customer stocks are set at levels generating a profit.

The model includes one other major assumption. Ittner and Larcker [1998a] report diminishing performance benefits at high satisfaction levels. To incorporate this diminishing impact, the implemented model does not reward the firm for employee satisfaction and customer satisfaction levels above the target value of 90. Specifically, employee productivity and employee turnover levels remain constant when employee satisfaction equals 90 to 100. Similarly, sales revenue growth levels off at fifteen percent when customer satisfaction equals 90 to 100.

The target values are set at 90 because there is little difference between highly satisfied employees/customers and extremely satisfied employees/customers. For example, ECP firms, which are listed as one of the best 100 companies to work for in America, have non-zero voluntary turnover rates [Branch, 1999]. In addition, Ittner and Larcker [1998a, Table 2, p. 12] find

that the highest next period revenues are generated by the ninth decile, which has a mean customer satisfaction of 88.23.

Table 3 presents the values for all of the variables contained in the ECP model. These values designed to make the Always NFM, No NFM, and Intermittent NFM equivalent in the Time-Lag 0, non-stochastic environment. The Table 3 values are now described in detail beginning with the start of the model – Employee Support Expenditure decision-making.

Decision-Making Logic

Appendix A, Figure A1 presents the decision-making logic for selecting the appropriate Employee Support Expenditure level. As described in Section 3.2.3, managers make decisions based on the either net income, employee satisfaction, and/or customer satisfaction. For decision-making purposes, managers actually use the observed satisfaction measures, which are equal to the actual satisfaction factor plus a measurement error. To simulate satisfaction measures with a random, unknown level of measurement error, the errors are randomly selected from the distribution ~N(0,25) in the high NFM Measurement Error condition (see the converters called es measurement error and cs measurement error). To ensure independence, the customer satisfaction and employee satisfaction measurement errors are independently distributed.

Figure A1 shows a series of separate converters for the three decision frameworks. In the No NFM decision framework (see the converter called no nfm decision), only the prior period's net income amount is used to make the

Table 3: Selected Values[42]

Decision-Making: Employee Satisfaction and Customer Satisfaction

Employee Satisfaction Target Value = 90

Customer Satisfaction Target Value = 90

ES Expend Level	Implementation Rule: ES_{t-1} cutoff values	ES Expend Impact	Cost:ES Expenditure (% of $Sales_t$)
1	> 96	15	1%
2	[89, 96]	18	5%
3	< 89	20	10%

ES Expend Level	Implementation Rule: CS_{t-1} cutoff values	ES Expend Impact	Cost:ES Expenditure (% of $Sales_t$)
1	> 96	15	1%
2	[83, 96]	18	5%
3	< 83	20	10%

es measurement error = a random number selected from the distribution ~N(0,25)

cs measurement error = a random number selected from the distribution ~N(0,25)

[42] ES/es refer to employee satisfaction while CS/cs and NI refer to customer satisfaction and net income, respectively.

Table 3: Selected Values (continued)

Decision-Making: Net Income

revised FM Target Value = 1.15 NI_{t-1} (15 percent is the expected growth rate at customer satisfaction target of 90)

ES Expend Level	Implementation Rule: NI_{t-1} cutoff values	ES Expend Impact	Cost:ES Expenditure (% of $Sales_t$)
1	= 1.01(revised FM Target Value)	15	1%
2	(.94 (revised FM Target Value), 1.01 (revised FM Target Value))	18	5%
3	= .94 (revised FM Target Value)	20	10%

Employee

Employees (initial value) = 1,000

Employee Satisfaction Range = [0,100]

Initial Employee Satisfaction Value = 75

es shock = a random number that has a 10 percent chance of being selected from the distribution ~N(0,25), and a 90 percent chance of equaling 0

es decay fraction = 0.20

es time lag = 0 if Time-Lag equals 0; 1 if Time-Lag equals 1

hiring cost/employee = $225

Table 3: Selected Values (continued)

Customer

Customers (Initial) = 5,500

Customer Satisfaction Range = [0,100]

Initial Customer Satisfaction Value = 75

cs decay fraction = 0.55

cs shock = a random number that has a 10 percent chance of being selected from the distribution ~N(0,25), and a 90 percent chance of equaling 0

cs time lag = 0 if Time-Lag equals 0; 1 if Time-Lag equals 1

demand time lag = 0 if Time-Lag equals 0; 1 if Time-Lag equals 1

demand shock = if Demand Volatility is high, equals a random number selected from the distribution ~N(0, 0.0025); if Demand Volatility is zero, equals 0

Process

base productivity = 10 units per period

service lead time = Service Backlog/delivered services

services demanded = number of units demanded by a customer = 2 units

Financial

price per unit = $100

salary per employee per period = $450

hiring cost/employee = $225

Employee Support Expenditure decision.[43] In the Always NFM decision framework (see the converter called always nfm decision), the prior period's observed employee satisfaction (support decision \es), observed customer satisfaction (support decision \cs), and net income amounts (no nfm decision) are equally used to make the decision. In the Intermittent NFM decision framework (see the converter called intermittent nfm decision), customer satisfaction and employee satisfaction are used to make a decision every fourth period, while net income is used every period.[44]

The decision frameworks determine the appropriate level of Employee Support Expenditures to implement by comparing the pertinent measure (net income and/or employee satisfaction and customer satisfaction) to designated cutoff values in the decision rules. These net income, employee satisfaction, and customer satisfaction cutoff values have two purposes. First, the cutoff values are designed to make the No NFM, Intermittent NFM, and Always NFM decision frameworks equivalent when Time-Lag equals 0 periods and when there is no randomness in the system, i.e., No NFM Measurement Error, no Demand Volatility, and no random shocks. Second, the cutoff values are designed to make the three measures equal to their target values.

The decision rules, and the associated cutoff values, are formulated with the assumption that managers know the appropriate target values for the NFMs as well as the expected sales revenue growth rate (15 percent). As described above,

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[43] To simplify programming logic, the prior period's net income before Employee Support Expenditures is used in the No NFM decision framework.

[44] The converter called period counter causes the Intermittent NFM to switch between the No NFM and Always NFM decision frameworks every fourth period.

the employee and customer satisfaction target values are always fixed at 90, capturing the diminishing impact of satisfaction. The net income target changes from period to period, however. Initially, the net income target value is set to the amount generated by the initial employee satisfaction and customer satisfaction values. This initial amount provides a floor for the net income target throughout the simulation. The net income target value is updated throughout the simulation reflecting the expected growth of net income (at 15 percent). Specifically, the prior period's net income becomes the new target value if it is greater than the initial net income target (see the converters initial fin target and revised fin target).

Employee (Learning and Growth)

Appendix A, Figure A2 presents the stocks and flows for the next link in the ECP model, the Employee sector. Because the ECP model focuses on employees, the learning and growth dimension of the Balance Scorecard focuses on employee satisfaction, hiring, and turnover. Accordingly, the Employee sector calculates the employee satisfaction level and the number of employees for the period.

Employee Satisfaction

Current organizational theory posits that: (1) employee satisfaction is a function of situational and individual dispositional factors, (2) employees continuously adjust their attitudes upwards and downwards as conditions change, and (3) employee satisfaction changes slowly over time [Gerhart, 1987; Staw,

1986]. The top chain determining the stock of employee satisfaction reflects these premises. Specifically, the stock of employee satisfaction is increased by the inflow called es buildup (Figure A1), which is the net impact of Employee Support Expenditures and random shocks, and decreased by the outflow called loss of es, which represents the natural decaying process of employee satisfaction.

In Gerhart's [1987] terms, Employee Support Expenditures represent the situational factors affecting employee satisfaction. Higher levels of Expenditures lead to higher levels of employee satisfaction. However, it may take several periods for the Expenditures to improve employee satisfaction. Therefore, the employee satisfaction chain incorporates the Time-Lag condition by delaying the impact of Employee Support Expenditures (es expend impact).[45] The converter called es time lag specifies the delay, or number of periods that it takes employee satisfaction to reflect the period's Employee Support Expenditures. When Time-Lag equals 0, Employee Support Expenditures increase employee satisfaction during the same period in which they are implemented (es time lag equals 0). When Time-Lag equals 1, Employee Support Expenditures increase employee satisfaction during the next period (es time lag equals 1).

The second converter driving employee satisfaction buildup is the period's employee satisfaction random shock (see es shock). Random shocks include external shocks, such as labor disputes, as well as employees' dispositional factors that may affect employee satisfaction, but that are out of the firm's

[45] There are two converters used for the Employee Support Expenditures. The first, expend decision, represents the selected level of 1, 2, or 3. The second, es expend impact, converts the decision level to the corresponding amount of the employee satisfaction increase. The es expend impact amounts are the amounts that sustain the target satisfaction values in the non-stochastic, Time-Lag 0 condition.

control. These employee satisfaction shocks have a 10 percent chance of being selected from the distribution ~N(0, 25) and a 90 percent chance equaling zero. Thus, random shocks could have a positive or negative effect on the impact of Employee Support Expenditures.

Employee satisfaction is drained each period by a passive decay (see the outflow called loss of es). This loss assumes that if efforts are not made to continuously support employees (through Employee Support Expenditures), employee satisfaction decreases at a rate of 20 percent per period (see es decay fraction). The rate of 20 percent reflects that employee satisfaction changes slowly over time.

Number of Employees

The Employee sector also calculates the number of employees working for the firm during the period. The stock of employees is increased by the number of employees hired during the period, and drained by the number of employees quitting (see the flows called hiring and quitting). The firm incurs a fixed amount of $225, or a half period's salary, for each employee hired and employees are hired for 3 different reasons.[46]

Employees are hired to replace departing employees to ensure that enough employees are available to meet the service demands (see the converter called hiring to replace attrition). To prevent excess hiring, this attrition replacement

[46] Weaver [1999] states that hiring/training costs are up to three times the salary level. A hiring cost equal to half a period's salary represents a conservative estimate of the total cost that a firm incurs to hire a new employee.

occurs only if excess production capacity is less than ten percent (see excess capacity %). Employees are also hired to make sure that production capacity grows at the same pace as sales revenue (see hiring growth rate). Finally, employees are hired when the service lead time (determined in the Process sector) exceeds 0.10 periods, indicating that customers are waiting too long for service (see additional emp needs). A cutoff value of 0.10 is selected because at that level, only a low percentage (3.3 percent) of the current customers will leave (this is discussed in the Customer sector).

The two chains of the Employee sector are linked. The number of employees quitting is driven by the employee turnover ratio, which is a nonlinear function of employee satisfaction. Specifically, employee turnover increases as employee satisfaction decreases according to the non-linear function shown in Appendix B, Figure B1.[47] To capture the diminishing impact of employee satisfaction, employee turnover levels off at 3 percent when employee satisfaction equals 90. 3 percent was selected because it is the voluntary turnover rate at Federal Express, an ECP firm [Branch, 1999].

Customer

Appendix A, Figure A3 presents the stocks and flows for the customer section of the ECP model. The customer sector calculates the customer satisfaction level as well as the number of customers for the period.

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[47] *ithink* identifies functions with a ~ in the converter.

Customer Satisfaction

The ECP model asserts that customer satisfaction is built during a long-term relationship with the firm. This implies that customer satisfaction is cumulative not transaction specific.[48] Moreover, marketing research posits that not only is customer satisfaction a function of past experiences, but also service level, product quality, and price [Anderson et al., 1994; O'Malley, 1997; Foster and Gupta, 1998]. Because this study holds price constant and the firm sells an experience good, the study models the stock of customer satisfaction as a function of past experience, current service level, and a random shock. Specifically, the stock of customer satisfaction is increased inflow called cs buildup, which is the net impact of the service level (as proxied by employee satisfaction) and random shocks, and is decreased by the outflow called loss of cs, which represents the natural decaying process of customer satisfaction.

Customer satisfaction is drained each period by a passive decay (see loss of cs). This decay is the result of the passage of time and reflects Anderson et al.'s [1994] finding that customers weight previous experiences with the firm less than the most recent experiences. Thus, the prior period's customer satisfaction level is a proxy for the customer's (prior) experience with the firm. To reflect the

[48] There are two types of customer satisfaction - transaction and cumulative. Transaction specific satisfaction measures the customer's experience with the firm on one specific purchase. Cumulative satisfaction measures the customer's satisfaction over the entire relationship with the firm. Cumulative satisfaction is used in this study because it "is a more fundamental indicator of the firm's past, current, and future performance. It is the cumulative satisfaction that motivates a firm's investment in customer satisfaction" [Anderson et al., 1994].

relative weighting of current and past experiences, customer satisfaction decays at a rate of 55 percent per period (see cs decay fraction).[49]

The current level of service, proxied by employee satisfaction, increases customer satisfaction (see es effect).[50] Moreover, customer satisfaction may take several periods to reflect the service quality levels. Therefore, this section of the model also incorporates the Time-Lag condition, indicating the number of periods that it takes for the service quality to be reflected in customer satisfaction. When Time-Lag equals 0, the service quality affects customer satisfaction immediately (cs time lag equals 0). When Time-Lag equals 1, the full impact of service quality is not reflected in customer satisfaction until the next period (cs time lag equals 1). Finally, external random shocks (see cs shocks) represent items that may affect customer satisfaction, are out of the firm's control, and have a 10 percent chance of being selected from the distribution ~N(0, 25) and a 90 percent chance equaling zero. Thus, the random shocks may have a positive or negative effect on the impact of service quality/employee satisfaction.

Number of Customers

The customer sector also calculates the number of customers during the period. If customer satisfaction is high, customers reward the firm with positive

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[49] A decay rate of 0.55 indicates a coefficient of .45 on the prior period's customer satisfaction level. This coefficient is consistent with the findings of Anderson et al. [1994] who report a coefficient of 0.44 on prior period customer satisfaction and 0.49 on quality.

[50] Due to the fact that it is highly unlikely that a unit of employee satisfaction translates to a unit of customer satisfaction, the employee satisfaction effect equals the employee satisfaction level times a percentage (es impact). To be consistent with Anderson et al. [1994], es impact is set at 0.55, which makes the current period customer satisfaction level equal to 45 percent of the prior period's customer satisfaction level plus 55 percent of the current employee satisfaction level plus random shocks.

word-of-mouth advertising attracting new customers, so the number of customers is appropriately increased by a percentage. If customer satisfaction is low, customers penalize the firm with negative word-of-mouth advertising deterring new customers, so the number of customers is appropriately decreased by a percentage. The increasing/decreasing word-of-mouth percentage is called the wom multiplier, which is a non-linear function of customer satisfaction as shown in Appendix B, Figure B2.[51] To reflect the diminishing impact of satisfaction, the word-of-mouth multiplier levels off at 15 percent when customer satisfaction equals the target value of 90.

The Time-Lag and Demand Volatility conditions also affect the growth of customers flow. Specifically, if Time-Lag is 0, the customer satisfaction level affects the number of customers immediately (demand time lag equals 0). If Time-Lag is 1, the customer satisfaction level affects the number of customers the next period (demand time lag equals 1). When Demand Volatility is high, the prior period's number of customers is multiplied by a random number, selected from the distribution ~N(0, 0.0025), to represent (positive or negative) changes in demand that the firm can not control (or predict) (see demand shock).

Finally, the number of customers is drained by the outflow called lost customers, which represents customers not buying from the firm again. The number of lost customers is based on service lead times, which represents the time customers must wait for service (described in the Process sector). The longer customers wait, the more customers leave the firm. This non-linear function,

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[51] Figure B2 is roughly based on Figure 3 in Ittner and Larcker [1998a, p. 11] which graphs customer satisfaction index (in 1996) and predicted revenue changes from 1995 to 1996.

designed to punish a firm for long service lead times, is shown in Appendix B, Figure B3. Thus, a firm can lose a customer in 2 ways: (1) not providing high quality customer service or (2) not providing timely service.

Process

Appendix A, Figure A4 presents the stocks and flows for the Process sector. This sector has one main chain representing the internal operations of the ECP model. The stock of Service Backlog equals the number of outstanding services. Service Backlog is increased by the inflow new service orders, representing the number of service orders demanded, and decreased by the outflow called delivered services, representing the number of units completed during the period. Each customer orders 2 units (services demanded).

The number of services delivered during the period decreases Service Backlog (see delivered services). Delivered services is a function of the number of employees and the average productivity of employees. Thus, delivered services is equivalent to the capacity of the system during the period. The level of productivity is a function of a base productivity level adjusted for the level of employee satisfaction. As employee satisfaction increases, the level of productivity increases according to the function shown in Appendix B, Figure B4. Employee productivity levels off when employee satisfaction equals the target value of 90. The productivity curve used here presents a more conservative estimate of productivity than that used in a sample *ithink* Balanced Scorecard

model developed by High Performance Systems, Inc. [High Performance Systems, 2000].

The last component in this sector is service lead time. Service lead time is a function of Service Backlog and delivered services (Service Backlog/delivered services). Increasing service lead times indicate that customers are waiting longer to be served which will increase customer turnover (see the Customer sector). The firm can decrease the service lead time by hiring additional employees (see the Employee sector) and/or increasing employee satisfaction and productivity.

Financial

Appendix A, Figure A5 presents the last sector of the implemented ECP model, the Financial sector. This sector contains one main chain that calculates the stock of Retained Earnings, which is increased by the revenue inflow and decreased by the expense outflow. Revenues are a function of the price of services ($100/unit) and the number of services delivered during the period (see the converters called price per unit and delivered services). Expenses consist of salary expense, hiring costs, and Employee Support Expenditures. In addition, net income is calculated each period (revenues minus expenses).

Salary expense is a function of the number of employees working for the firm during the period and the salary per employee (see the converter called salaries). The salary level has been set at the level of an actual ECP firm, Federal Express, compensating employees at a rate of 45 percent of sales revenue. Using the base productivity rate to determine compensation, the salary per period equals

$450. Hiring costs are a function of the number of employees hired during the period and the hiring cost per employee, which is equal to half a period's salary or $225 (see the converter called hiring costs). Employee Support Expenditures are a function of the period's sales revenue and the level of Employee Support implemented during the period (see the converter called es expenditures). The cost percentages of the Employee Support Expenditures are shown in Table 3 and have been defined similar to Federal Express, which places ten percent of profits into a profit-sharing plan [Branch, 1999, p. 140]. Appendix C contains the code generating the ECP model in Appendix A, Figures A1 – A5.

Timeframe

The system is simulated for a finite period of time, 100 periods.[52] 100 periods was selected because few firms have a planning horizon longer than this time length. In addition, the length of the simulation should help assess the real benefits of using NFMs in managerial decision-making in the long-term and is in sharp contrast to existing empirical studies discussed in Chapter 2, which generally use 2 or 3 years of annual data.

3.3 RATIONALE FOR A SIMULATION STUDY

This section describes simulation methodology (in general) and how the business world and research studies have used simulation. The section then

[52] I do not designate a period as a month or quarter intentionally because I am assessing the *relative* performance of a firm incorporating NFMs into decision-making with varying frequency. A month or quarter designation would not change the results.

discusses why simulation is the appropriate method to examine the simplified ECP business model in a service firm.

Simulation (in general)

Simulation is "the process of designing and creating a computerized model of a real or proposed system for the purpose of conducting numerical experiments to give us a better understanding of the behavior of that system for a given set of conditions" [Kelton, Sadowski, and Sadowski, 1998, p.7]. One of the main advantages of simulation is that the methodology imparts insight into a system even when (1) experimenting on the actual system is impossible due to high costs or other limitations (i.e., physical, temporal, etc.) or (2) the system is so complex that it cannot be modeled analytically without restrictive mathematical and statistical assumptions that produce results not precise enough to be useful for the "real world."[53]

In the business world, most simulation studies compare different configurations of the system in order to see how changes in design, parameters, or operation affect performance [Kelton, Sadowski, and Sadowski, 1998]. In order to save time and reduce risk, simulation is used in a wide variety of manufacturing and service industries to examine a wide variety of problems including: business process reengineering, enterprise resource planning implementations, supply chain analysis, investment, forecasting, and logistics [Evans, Naim, Towill, 1993; Lenz and Neitzel, 1995; Banks, 1998; Curry and

[53] Knechel [1983] makes this argument for the use of computer simulation to evaluate the effectiveness and reliability of internal control systems.

Peel, 1998; Weil, 1998]. For example, in the automotive manufacturing industry, no major investment ($10 million) is made unless a simulation analysis justifies that investment [Banks, 1998].

Accounting research has also used simulation to study a wide variety of problems. Several studies examine system reliability (internal controls) [Burns and Loebbecke, 1975; Stratton, 1981; Knechel, 1985]. Another group examines audit sampling properties to determine the best sampling design [Smieliauskas, 1986; Tamura and Frost, 1986; Roshwalb and Wright, 1991; Wurst, Neter, and Godfrey, 1991]. Other studies analyze a broad range of areas including the following topics: activity-based costing [Maher and Marais, 1998]; detecting earnings management [Dechow, Sloan, and Sweeney, 1995]; the impact of errors on accounting return estimates of internal rate of returns [Fritsche and Dugan, 1997]; leverage and audit firm mergers using a simulated market of pure price competition [Doogar, Easley, and Ricchiute, 1998]; optimal LIFO and FIFO policies [Biddle and Martin, 1986]; the marginal cost of a service department [Lambert and Larcker, 1989]; and stock return skewness distributions [McNichols, 1988]. The next subsection discusses simulation methodology in terms of the current study.

Simulation and the proposed ECP Model

To evaluate the gains from introducing NFMs into the managerial decision process, the ultimate decisions and financial outcomes of each decision framework must be compared over a period of time. Testing the impact of NFMs

requires a decision maker to (1) make a decision based on FMs, execute that decision, determine the period's financial results and then (2) repeat the period, facing the same external and internal conditions, except for making the decision based on NFMs. A test of this nature is not possible with traditional empirical research methods because decisions can be made only once and the period cannot be re-lived in the "real world."[54] However, simulation makes this dual-decision world possible by using the same information inputs for each decision framework in each period holding all other external and internal conditions constant. Thus, the only difference between the simulation runs is whether NFMs are used in decision-making.

Simulation also allows the ECP model to be studied in detail. First, simulation permits the decision frameworks to be compared over long periods of time, allowing a better assessment of the real benefits of integrating NFMs into the decision-making process. Most empirical research has only studied NFMs using two or three years of data [Anderson, Fornell, and Lehmann, 1994; Anderson, Fornell, and Rust, 1997; Banker, Potter, and Srinivasan, 1998; Fargher, Gorman, and Wilkins, 1998; Foster and Gupta, 1998; Ittner and Larcker, 1998a; Nagar, 1998]. In addition, many studies rely on annual data only, not quarterly (or monthly) information [Anderson, Fornell, and Lehmann, 1994; Anderson, Fornell, and Rust, 1997; Nagar, 1998].[55] Second, simulation allows the impact of

[54] While behavioral research could repeat the period under different decision frameworks, behavioral research introduces additional sources of error due to human processing and between subjects differences.

[55] Of all the prior studies listed in this paper, Amir and Lev [1996] have the longest study – ten years of quarterly data for 14 firms. In addition, Banker, Potter, and Srinivasan [1998] examine monthly data for six years. Chandra, Procassini, and Waymire [1996] examine eight and a half years of monthly data but industry, instead of firm-specific, NFMs are used.

NFM measurement frequency to be examined (Always NFM versus Intermittenet NFM). Third, simulation allows the three conditions (Time-Lag, NFM Measurement Error, and Demand Volatility) to be studied to help understand how the conditions affect the value of NFM usage. Finally, simulation allows sensitivity analysis of all of the variables.

3.4 COMPARISON OF THE CURRENT STUDY WITH PRIOR ACCOUNTING STUDIES OF THE BENEFITS OF NFMS

This study expands our understanding of the importance of NFMs with respect to the managerial decision process in several ways. This study examines NFMs using a different methodology, system dynamics/simulation. David Norton, co-author of the Balanced Scorecard, states that "[t]he next generation of Balanced Scorecard will be built using dynamic simulation" [High Performance Systems, 2000]. Accordingly, this study uses a system dynamics, simulation model to analyze NFM usage. A dynamic model means that unlike most empirical and analytic studies that assume unchanging relationships between business components, this study uses closed-loop, causality relationships which reflect the interconnected and continuously evolving "real world." The model also incorporates non-linear relationships found in the real world (i.e., the employee satisfaction – employee turnover relation). Thus, this study attempts to expand our understanding of NFMs using a methodology that captures the non-linear relationships that drive businesses.

Moreover, compared to analytical studies, the methodology helps capture the complexity of the "real world."[56] Due to mathematical restrictions, analytic models represent a simplified version of the world in terms of time periods (two or less), changing conditions/assumptions (generally one at a time), and variable definitions (i.e., permitting negative sales volume [Hauser et al., 1994]). In addition, all of the studies ignore the cumulative effect of NFMs. For example, customer satisfaction changes slowly over time, reflecting revisions in customers' beliefs about a firm, but the analytical studies do not capture this effect. System dynamics models capture the complexity of the business world with multiple time periods, multiple conditions that change simultaneously, and realistic variable definitions. Consequently, the results from this study should be easier to interpret and incorporate into business operations, and should increase our understanding of the ultimate impact of NFM usage.

The system dynamics methodology also allows the current study to contribute to research in several areas. First of all, the study attempts to directly assess the benefits of integrating NFMs into decision-making. Prior empirical studies cannot make this assessment because (real) firms cannot contemporaneously operate in a dual-decision world. Therefore, most extant literature has only *indirectly* studied the importance of NFMs, focusing on the historical relationship of *available* NFMs with earnings, returns, and prices at the firm level.

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[56] Forrester [1961, p.17] states that "mathematical analysis is not powerful enough to yield general analytical solutions to situations as complex as are encountered in business."

Second, because the methodology can manipulate the selected conditions while controlling all other external and internal conditions, the study gains new insights into how select conditions affect the benefits of integrating NFMs into decision-making. A few extant studies examine how strategy and firm structure may affect the benefits of using NFM, but this study specifically examines how NFM measurement frequency and changing operating conditions affect the pattern of costs and benefits of NFM usage. An understanding of the pattern of costs and benefits is needed to help explain the mixed results of NFM usage by businesses and NFM empirical research.

Third, system dynamics/simulation permits NFMs to be studied over a long time horizon. In contrast, prior empirical NFM studies generally examine a short period of time, 2 or 3 years of data, because most firms have recently begun using NFMs in decision-making. A long time window is necessary to examine the pattern of costs and benefits of these forward-looking, NFMs.

The next chapter presents and discusses the results of the system dynamics simulation.

Chapter 4: Data Analyses, Discussion, and Summary of Results

4.1 Overview

This chapter reports and discusses the results for the ECP model and conditions outlined in Chapter 3. The model and studied conditions are examined by implementing several decision frameworks/rules, which remain constant as the operating conditions change via a computer simulation. The simulations are run as if a firm adopted the ECP philosophy at the beginning of time period 1 and is using the Always NFM, No NFM, and Intermittent NFM decision frameworks to implement the strategy. Therefore, the short-term results reflect the adjustment period that a firm undergoes as it incorporates the ECP philosophy into the decision process. All three decision frameworks generate positive net incomes in all studied conditions, so this study attempts to identify which decision framework has the highest probability of generating larger profits.

The next section consists of several sub-sections that discuss the results of these simulations. Because managers want to maximize net income and minimize the uncertainty of the outcome measures, the dependent variables are analyzed in terms of mean values as well as variance. The results are presented with and without the employee satisfaction and customer satisfaction random shocks to isolate their effect. Finally, descriptive statistics and graphs analyze the relation of the selected variables over the 100 period simulation horizon.

4.2 RESULTS OF THE SIMULATION

4.2.1 Overview

This section presents a high-level overview of the results, while the next three sections discuss the specific impact of Time-Lag, NFM Measurement Error, and Demand Volatility. Because lengthening Time-Lag from 0 periods to 1 period has a minimal impact on the differences between the Always NFM and No NFM simulation results in the non-stochastic environment, simulations were also run for a Time-Lag of 2 periods. All simulations were run using Common Random Numbers, which reduce variability due to pure randomness and enhance variability due to differences in decision-making.[57] The appropriate method for comparing systems using Common Random Numbers is to examine the average differences of the simulation outputs [Law and Kelton, 1991]. In this study, the appropriate differences to examine are the Cumulative Net Income Differences, which are defined in Chapter 3 and presented in Tables 4 and 5.

Paired t-tests incorporating the Bonferroni correction tested the significance of the Cumulative Net Income Differences [Law and Kelton, 1991, p. 587]. Table 4 reveals that the Always NFM results are generally significantly different from the No NFM results, indicating that the two decision frameworks generate distinct financial results over the simulation. On the other hand, Table 5 reveals that the Intermittent NFM results are not significantly different from the

[57] Practically, this means that for each simulation run (i.e., simulation run #1) the same random number is used for all three decision frameworks. Therefore, any observed differences cannot be attributed to using different random numbers. Rather, differences are attributed to the decision rules used to select the Employee Support Expenditure levels.

No NFM results, indicating that incorporating non-financials into decision-making (only) on an infrequent basis does not significantly improve or impair the firm's financial performance.

Appendix D, Figures D1, D2 and D3 present summary graphs for the average employee satisfaction level in each Time-Lag condition. The graphs present the average value for each decision framework across the 8 possible different condition combinations.[58] The graphs show that the Always NFM decision framework, in general, performs better than the Intermittent NFM and No NFM decision frameworks supporting the Table 4 and 5 results (i.e., the Always NFM line is almost always above the No NFM and Intermittent NFM lines in all conditions except for employee turnover). Moreover, the Intermittent NFM results are between the Always NFM and No NFM results, but tend to be closer to the No NFM results, supporting the insignificant results in Table 5. The remaining dependent variables, profit margin, employee turnover, employee productivity, Employee Asset Value, customer growth, and Customer Asset Value, follow a similar pattern (not shown).

4.2.2 Time-Lag

The first condition, Time-Lag, represents the length of time (periods) that it takes for changes to traverse each link in the ECP chain (Employee Support Expenditures, employee satisfaction, customer satisfaction, net income). The selected decision rules were designed to generate identical results for the three

[58] The graphs present the average values based on 15 simulation runs.

decision frameworks in a non-stochastic, Time-Lag 0 condition (i.e., no NFM Measurement Error, no Demand Volatility, and no employee satisfaction and customer satisfaction shocks). Tables 4 and 5 confirm that the decision frameworks are equivalent in the Time-Lag 0, non-stochastic environment because the Cumulative Net Income Differences are equal to zero. These non-stochastic results act as a reference point for evaluating the remaining simulations.

The expectation was that lengthening the Time-Lag would increase the benefits (i.e., Cumulative Net Income Difference$_i$) associated with NFM usage. Table 4, however, shows that the Difference increases only when there are no shocks and no Demand Volatility. In fact, 18 out of 24 Cumulative Net Income Difference$_i$s decrease.

To understand the varying effect of Time-Lag, the average value and the time-series pattern of the dependent variables needs to be explored. Appendix D, Figures D4, D5, D6 graph the average value of employee satisfaction across the 8 condition combinations as Time-Lag increases. Figure D4, for example, shows that the average employee satisfaction level for the Always NFM decision framework decreases as Time-Lag increases. Moreover, as Time-Lag increases, the averages for customer satisfaction, profit margin, employee productivity, Employee Asset Value, customer growth, and Customer Asset Value also decrease for all three decision frameworks, while the average employee turnover increases (Figures D7 – D12). Increasing Time-Lag from 0 to 1 reduces all three Retained Earnings by approximately 50 percent, while an increase from 0 to 2 reduces Retained Earnings by 79, 95, and 89 percent in the Always NFM, No

NFM, and Intermittent NFM Retained Earnings, respectively. Therefore, the conclusion can be made that a longer Time-Lag reduces system performance.

Table 4: Cumulative Net Income Difference$_1$: Always – No NFM (millions)

Panel A: No Employee Satisfaction and Customer Satisfaction Shocks[59]

	Time-Lag 0		Time-Lag 1		Time-Lag 2	
	No ME	ME	No ME	ME	No ME	ME
DV 0	0	(607,600)[1]	0.13[1]	(381,504)[1]	406,105[1]	193,144[1]
DV High	378,311[1]	275,054[1]	229,037[1]	116,597[1]	82,375[1]	55,737[1]

The boxed row highlights the non-stochastic (base) results.

Panel B: Employee Satisfaction and Customer Satisfaction Shocks

	Time-Lag 0		Time-Lag 1		Time-Lag 2	
	No ME	ME	No ME	ME	No ME	ME
DV 0	299,693[3]	141,044	89,648	8,568	25,685	(21,611)
DV High	193,001[1]	128,125[1]	97,565[1]	68,730[3]	44,613[1]	30,676[2]

[1]/[2]/[3] indicates that the differences are significant at the 0.01/0.05/0.10 levels (incorporating the Bonferroni correction)

[59] DV refers to Demand Volatility.

Table 5: Cumulative Net Income Difference$_2$: Intermittent – No NFM (millions)

Panel A: No Employee Satisfaction and Customer Satisfaction Shocks

	Time-Lag 0		Time-Lag 1		Time-Lag 2	
	No ME	ME	No ME	ME	No ME	ME
DV 0	0	(123,408)	0	(168,134)	165,490	38,885
DV High	67,463	50,327	22,034	9,486	14,737	14,851

Panel B: Employee Satisfaction and Customer Satisfaction Shocks

	Time-Lag 0		Time-Lag 1		Time-Lag 2	
	No ME	ME	No ME	ME	No ME	ME
DV 0	77,351	60,362	(228)	(48,806)	(31,844)	(46,882)
DV High	(4,634)	18,632	15,061	7,095	6,737	14,855

$^{1}/^{2}/^{3}$ indicates that the differences are significant at the 0.01/0.05/0.10 levels (incorporating the Bonferroni correction)

Appendix D, Figures D13 through D17 graph the time-series pattern for the dependent variables across the simulation horizon without NFM Measurement Error, Demand Volatility, and employee satisfaction and customer satisfaction shocks. These time-series graphs not only isolate the Time-Lag effect, but also help explain why the average dependent variable decreases with an increase in

Time-Lag. Moreover, the different Time-Lags (0, 1, and 2) give us three different scenarios under which to study the various frameworks - when the frameworks make identical, similar, and completely different decisions.

Longer Time-Lags make it harder to manage the satisfaction measures especially for the No NFM decision framework. Specifically, the No NFM and Intermittent NFM decision frameworks make (essentially) the same Expenditure decisions as the Always NFM decision framework until Time-Lag equals 2 (Figure D13).[60] When Time-Lag equals 2, the Always NFM decision framework pursues a steady Expenditure policy, while the No NFM decision framework begins to oscillate in period 17 – as it attempts to stabilize net income by over and under spending on Employee Support Expenditures (Figure D14). The Intermittent NFM decision framework follows a similar oscillating pattern before stabilizing in period 46.

This oscillating behavior is seen throughout the simulation results. To completely understand why the simulations are exhibiting this behavior pattern, a brief description of oscillation follows. Oscillations are one of the fundamental modes of behavior for dynamic systems. Oscillations are caused by negative feedback loops, which are designed to bring the system back in line with a specified goal by comparing the system's current state with the desired goal and then taking corrective actions to eliminate any discrepancies. In this context, the goal is maintaining high levels of satisfaction. Significant time delays in the

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[60] When Time-Lag equals 1, the three decision frameworks are identical with the exception of the Expenditure decisions in periods 10 and 11. The Always NFM decision framework (correctly) reduces its level of Employee Support Expenditures 2 periods before the No NFM and Intermittent NFM decision frameworks. The overall pattern is similar to Figure D13.

negative feedback loop cause the overshooting pattern because "the time delays cause the corrective actions to continue even after the system reaches its goal, forcing the system to adjust too much, and triggering a new correction in the opposite direction" [Sterman, 2000, p. 114]. When Time-Lag equals 2, the Always NFM decision framework provides managers with timelier measures of satisfaction, preventing the oscillation pattern seen in the No NFM decision framework.

The different Expenditure patterns cause the satisfaction factors to have distinct patterns. Longer Time-Lags (increasingly) delay the positive impact of the Employee Support Expenditures, making it harder to manage the satisfaction measures. Unlike the Time-Lag 0 satisfaction measures which steadily increase to the target values during the simulation, the Time-Lag 1 and Time-Lag 2 satisfaction measures decrease first and then overshoot the target values (Figures D15 and D16).[61] Moreover when Time-Lag equals 2, the oscillating No NFM Expenditure pattern causes the No NFM satisfaction levels to oscillate as well (a pattern called growth with overshoot behavior [Sterman, 2000, p. 108]) (Figure D16).

The remaining dependent variables (profit margin, employee turnover, employee productivity, Employee Asset Value, customer growth, and Customer Asset Value) follow the same general pattern as the satisfaction measures. Specifically, the variables steadily increase over the simulation in the Time-Lag 0

[61] In the Time-Lag 1 condition, the Always NFM satisfaction levels stabilize at the target value 4 periods earlier than the No NFM and Intermittent NFM decision frameworks (period 42 versus 46 for employee satisfaction and period 45 versus 49 for customer satisfaction).

condition but decrease before increasing in the Time-Lag 1 and Time-Lag 2 conditions.[62] The No NFM variables oscillate in Time-Lag 2. This (decrease-before-increase) pattern explains why the average performance of the system declines as Time-Lag increases especially for the No NFM decision framework.

Net income climbs exponentially, as modeled, for all three decision frameworks and Time-Lags. Interestingly, when Time-Lag equals 2, the Cumulative Net Income Difference$_t$, is initially zero through the first 12 periods (Figure D17). During the next 18 periods, the difference is small, or even negative, before increasing exponentially during the remaining 70 periods (not shown). This result demonstrates why some firms may abandon NFMs after a short usage period – they do not wait long enough to see the increasingly profitable results that can be accrued from NFM usage. For example, if a simulation period is equivalent to a calendar month, it would take 2 – 2.5 years to see improved profitability.

When employee satisfaction and customer satisfaction shocks are introduced into the system, the variability of the entire system increases. This variability causes the both the No NFM and the Always NFM dependent variables to never stabilize as depicted by the average Employee Support Expenditures in Figure D18.[63] Both the average (overall) and within period standard deviations increase, as represented by employee satisfaction in Figures D19 and D20, but

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[62] Employee turnover behaves in the opposite fashion, increasing before decreasing, in the longer Time-Lags.

[63] To be absolutely precise, the oscillation begins with Employee Support Expenditures and cascades down through the other dependent variables.

Time-Lag mitigates the increase.[64] However, shocks do not change the relation between the standard deviations of the Always NFM and No NFM dependent variables – the Always NFM dependent variables have lower standard deviations with and without the shocks.

Another method to examine the impact of shocks is studying the average period difference between the Always NFM and No NFM dependent variables. A period difference is the difference between the Always NFM and No NFM value in one period of a "matched" simulation run. The average period difference is the average of these differences. Figure D21 shows that shocks increase the average period difference of the employee satisfaction measures from the base when Time-Lag equals 0 or 1 and decreases when Time-Lag equals 2 – a pattern that cascades down to the Cumulative Net Income Difference$_1$ (Table 4, Panel A versus Panel B, DV 0). Overall, the average period differences with shocks decrease as Time-Lag increases, explaining why the Cumulative Net Income Difference$_1$s decrease (and become insignificant) as Time-Lag increases when shocks are present (Table 4, Panel B, DV 0).

The above results show that increasing Time-Lag and introducing shocks reduces the profitability of the firm because the environment is more difficult for the firm to manage and it takes longer for the satisfaction measures to reach their target values. Moreover, in a non-stochastic environment with a relatively short

[64] The best way to understand the standard deviations is to picture the dependent variable as the average surrounded by a band with a width equal to +/- 3 times the standard deviation. The average *overall* standard deviation first calculates the average standard deviation of the values in a 100 period simulation run and then averages the fifteen standard deviations. The average *within* period standard deviation first calculates the standard deviation of the values in one period for all fifteen simulation runs (e.g., the standard deviation of the fifteen values in period 5) and then computes the average of those standard deviations over the 100 periods.

Time-Lag the same operating results can be achieved using non-financials ***or*** financials in decision-making. As the Time-Lag grows longer, firms are managed more effectively and profitably by incorporating non-financials into the decision-making process. However, introduction of employee satisfaction and customer satisfaction shocks reduces the benefits of using NFMs, and, if the shocks are large enough, may completely eradicate the benefits of NFM usage. The next section discusses the second studied condition, NFM Measurement Error.

4.2.3 NFM Measurement Error

The second condition, NFM Measurement Error, represents the level of imprecision or noise contained in the employee satisfaction and customer satisfaction measures. The expectation is that measurement error decreases the benefits of incorporating NFMs into decision-making. Introducing measurement error into the simulation affects the Always NFM results (and to a lesser extent the Intermittent NFM results), but does not affect the No NFM results because the No NFM decision framework does not use NFMs to make decisions.[65] Therefore, any changes in the comparative measures are due solely to changes in the Always NFM decision framework as discussed below.[66]

NFM Measurement Error acts like a small shock that affects the Always NFM decision framework. The Error causes the Always NFM decision

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[65] This is why the No NFM decision framework in Figure D5 contains "plateaus" as one moves across the conditions. A similar pattern holds for the remaining dependent variables.

[66] NFM Measurement Error also affects (to a lesser extent) the Intermittent NFM decision framework. To show the full impact of NFM Measurement Error, the discussion focuses on the Always NFM decision framework.

framework to incorrectly change its Expenditure decisions and oscillate. The No NFM Expenditures level off when Time-Lag equals 0 and 1, but oscillate more than the Always NFM Expenditures when Time-Lag equals 2. This oscillation pattern cascades through the other dependent variables. The oscillation also causes the No NFM employee productivity, employee turnover, and customer growth to outperform their Always NFM counterparts when Time-Lag equals 0 and 1, and under-perform when Time-Lag equals 2.

NFM Measurement Error also has a financial effect. Always NFM Retained Earnings decrease 23, 29, and 40 percent from their Time-Lag 0, 1, and 2 base values, respectively. The Error also has a negative effect on the Cumulative Net Income Difference$_1$ (Table 4) and its time-series pattern (Figure D22). The Difference$_1$ turns exponentially negative in periods 10 and 36 for Time-Lag 0 and Time-Lag 1, respectively, while the Difference$_1$ turns exponentially positive in period 39 for Time-Lag 2 (after being negligible and even negative). Thus, when Time-Lag equals 2, NFM Measurement Error lengthens the time period required to see the positive results accrued from NFM usage from 12 periods to 39 periods (Figure D17 versus D22).

When shocks are present, NFM Measurement Error continues to have a negative effect on the Cumulative Net Income Difference$_1$, but the Difference$_1$s are no longer significantly different (Table 4, Panel B, DV 0). The shocks increase the volatility of the No NFM operating environment as well as the Always NFM environment, whose volatility is also increased by NFM Measurement Error. The Always NFM and No NFM variables do not stabilize

and the average (overall) and within period standard deviations increase. As depicted by employee satisfaction in Figure D20, the shocks increase the within period standard deviation of the Always NFM measures more than NFM Measurement Error. Interestingly, shocks increase the within period standard deviation of the No NFM measures beyond the standard deviation of the Always measures affected by shocks ***and*** measurement error. A similar pattern holds for the average standard deviation values (Figure D19).

The above results show that NFM Measurement Error reduces the benefits of using NFMs in decision-making. If the Time-Lag is longer, however, NFM usage is beneficial to the firm, even with measurement error, but the firm must wait longer to accrue the benefits. The presence of NFM Measurement Error and shocks increases the volatility of the operating environment, dramatically reducing (even eradicating) the benefits of using NFMs in decision-making. The next section discusses the last studied condition, Demand Volatility.

4.2.4 Demand Volatility

The third condition, Demand Volatility, represents the market's (unit) demand for the firm's products that is not driven by the customer satisfaction level. The expectation is that increasing Demand Volatility should increase the benefits of using NFMs in decision-making because NFMs are not affected by changing demand while FMs are affected. Thus, the Always NFM (and Intermittent NFM) decision framework should outperform the No NFM decision framework.

Table 4 reports that when Demand Volatility is high, the Cumulative Net Income Difference$_1$ is significantly positive, indicating that the Always NFM decision framework consistently outperforms the No NFM decision framework when the demand for products cannot be accurately predicted.[67] Surprisingly, Demand Volatility does not always increase the Cumulative Net Income Difference$_1$s (compare the DV 0 results with the DV High results in Table 4). To understand the phenomenon, the impact of Demand Volatility is now described in detail.

Demand Volatility reduces the Retained Earnings generated by all decision frameworks because of the negative demand shocks. The percent reduction of Retained Earnings is greater for the No NFM and Intermittent NFM decision frameworks than for the Always NFM decision framework, because Demand Volatility causes the No NFM and Intermittent decision frameworks to alter their Employee Support Expenditures as they react to demand changes. While the (average) No NFM and Intermittent NFM Expenditures oscillate in all three Time-Lags, the Always NFM Expenditures are negligibly affected by the Demand Volatility (only 6 of 4,500 decisions change).

The No NFM and Intermittent NFM Expenditure oscillation causes the average No NFM and Intermittent NFM employee satisfaction and customer satisfaction measures to oscillate. Because the No NFM decision framework makes inappropriate decisions, the average period difference between the Always NFM and No NFM satisfaction measures increase (Figure D21). The (overall)

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[67] While the Cumulative Net Income Difference$_2$s are generally positive, they are insignificant (Table 5).

average and within period standard deviation increase for the No NFM decision framework (Figures D19 and D20). Ultimately, the Always NFM dependent variables (profit margin, employee turnover, employee productivity, Employee Asset Value, customer growth, and Customer Asset Value) consistently outperform their No NFM counterparts as shown in Figures D7 through D12.[68]

An environment with all conditions present (Time-Lag, NFM Measurement Error, Demand Volatility, and employee satisfaction and customer satisfaction shocks) is the ultimate test of the benefits associated with NFM usage. Table 4 shows that these Cumulative Net Income Difference$_1$s are significantly positive and decrease as Time-Lag increases. While the Differences are positive, the presence of all conditions makes the system more variable because Employee Support Expenditures are not constant for both decision frameworks.

This volatility cascades to the satisfaction measures. The average period difference between the satisfaction measures remains positive but falls from the levels reported when only Demand Volatility and shocks are present (Figure D21). The (overall) average and within period standard deviations increase for both decision frameworks but the No NFM standard deviations remain higher (Figures D19 and D20). The Always NFM employee productivity, Employee Asset Value, employee turnover, customer growth, and Customer Asset Value, on average, outperform their No NFM counterparts (Figures D7 – D12). However, the difference between these dependent variables is not as great as when only

[68] The Intermittent NFM standard deviations and dependent variables fall between the No NFM and Always NFM results.

Demand Volatility. The Intermittent results are between the No NFM and Always NFM results (not shown).

The above results show that Demand Volatility increases the benefits of incorporating NFMs in decision-making even when NFM Measurement Error and employee satisfaction and customer satisfaction shocks are present. The Always NFM decision framework handles the volatility of the environment better, making decisions that increase profitability above that of the No NFM and Intermittent decision frameworks. Taking advantage of one of the benefits of simulation, the next section presents several sensitivity tests designed to gain a better understanding of the simulation results presented for Time-Lag, NFM Measurement Error, and Demand Volatility.

4.3 SENSITIVITY ANALYSIS

4.3.1 Period-by-Period Examination

Section 4.2 discusses the impact of Time-Lag, NFM Measurement Error, and Demand Volatility. With the exception of the non-stochastic base cases, Time-Lag has a negative impact on the Cumulative Net Income Difference$_1$. To understand why the Difference$_1$ decreases as Time-Lag increases, Table 6 identifies the payback or breakeven period for the Difference$_1$s across the different conditions. The payback period is the period when the Difference$_1$ turns (and remains) positive. For example, in the Time-Lag 0, no Demand Volatility condition with shocks, the Difference$_1$ is positive in period 16 when there is no

NFM Measurement Error, and positive in period 38 when there is NFM Measurement Error.

Table 6 helps explain why the Cumulative Net Income Difference$_1$ decreases as Time-Lag increases. As Time-Lag increases, the payback period increases. For example, when all conditions are present, the payback periods are periods 5, 9, and 44 for Time-Lags 0, 1, and 2, respectively. In Section 4.2, the dependent variables are analyzed using their 100 period averages. Given that the different conditions change the payback period, the dependent variables are likely to change across the simulation. Therefore, the dependent variables are now analyzed across the simulation horizon.

The best method for examining the Cumulative Net Income Difference$_1$s across the simulation horizon are growth rates because the exponential growth pattern of net income makes it difficult to compare the Difference$_1$s at different points in time. Three average growth rates are examined: (1) second half growth, the growth from period 51 to period 100, (2) average quarter growth, the average growth of the four periods – 1 to 25, 26 to 50, 51 to 75, and 76 to 100; and (3) average decile growth, the average growth of 10 periods – 1 to 10, 11 to 20, etc.

Table 7 presents the average second half growth rates. For 5 of the 8 possible condition combinations, the average growth rates increase as Time-Lag lengthens signaling that the Always NFM decision framework controls the unpredictable environments better (base, Demand Volatility, Demand Volatility and NFM Measurement Error, Demand Volatility and shocks, and Demand Volatility, NFM Measurement Error and shocks). The average quarter and

average decile growth rates follow a similar pattern with the exception of 2 values (of 24), but even in those 2 cases the Time-Lag 2 growth is always larger than the Time-Lag 0 growth (not shown).

Table 6: Cumulative Net Income Difference$_t$ Payback Period

Panel A: No Employee Satisfaction and Customer Satisfaction Shocks[69],[70]

	Time-Lag 0		Time-Lag 1		Time-Lag 2	
	No ME	ME	No ME	ME	No ME	ME
DV 0	NA	NA	10	NA	13	39
DV High	7	5	10	7	13	36

The boxed row highlights the non-stochastic (base) results.

Panel B: Employee Satisfaction and Customer Satisfaction Shocks

	Time-Lag 0		Time-Lag 1		Time-Lag 2	
	No ME	ME	No ME	ME	No ME	ME
DV 0	16	38	28	73	77	NA
DV High	7	5	10	9	28	44

The remaining 3 condition combinations (NFM Measurement Error, shocks, NFM Measurement Error and shocks) do not follow the same pattern.

[69] DV stands for Demand Volatility.

[70] NA means that the Cumulative Net Income Difference$_t$ remains less than or equal to zero throughout the 100 periods.

When (only) NFM Measurement Error is present, the average growth rate is always negative if Time-Lag equals 0 or 1. If Time-Lag equals 2, the average growth rate is not positive until the second quarter, and then rapidly recovers, indicating that the benefits of NFM usage eventually overcome the negative effects of NFM Measurement Error.

When (only) shocks are present, growth rates appear to increase and then decrease as Time-Lag increases. A close inspection reveals that increasing Time-Lag delays the positive benefits of NFM usage to the second and fourth quarters for Time-Lags 1 and 2, respectively. However, once the quarter growth is positive, the Time-Lag 2 growth rate is three times larger than the Time-Lag 1 growth rate. Finally, when NFM Measurement Error and shocks are both present (without Demand Volatility), the growth rates decline as Time-Lag increases due to the reinforcing negative impact of the Error and shocks. The growth rate is always positive, positive in the third quarter, and always negative in Time-Lag 0,1, and 2 conditions, respectively.

These results indicate that, in general, a longer Time-Lag increases the payback period required for NFM usage as well as the growth rate of the Cumulative Net Income Difference$_t$. These results suggest that while managers may have to wait longer to see the positive results of using NFMs as Time-Lag increases, firms will (eventually) accrue those benefits faster. However, NFM Measurement Error and shocks reduce the benefits associated with NFM usage, but the firm may eventually generate additional profits from NFM usage if the Time-Lag is longer. If both NFM Measurement Error and shocks are present

(without Demand Volatility), the firm may not benefit from NFM usage due to the reinforcing negative impact of both conditions.

Table 7: Average (Second Half) Growth Rates for Cumulative Net Income Difference$_1$ (in percentages)[71]

Panel A: No Employee Satisfaction and Customer Satisfaction Shocks[72]

	Time-Lag 0		Time-Lag 1		Time-Lag 2	
	No ME	ME	No ME	ME	No ME	ME
DV 0	0	(205,207)	0	(213,685)	214,655	219,942
DV High	63,262	60,397	87,868	65,444	92,161	98,973

The boxed row highlights the non-stochastic (base) results.

Panel B: Employee Satisfaction and Customer Satisfaction Shocks

	Time-Lag 0		Time-Lag 1		Time-Lag 2	
	No ME	ME	No ME	ME	No ME	ME
DV 0	150,262	240,065	361,762	15,696	57,568	(32,561)
DV High	52,291	45,835	71,559	113,043	108,928	220,882

Section 4.2 discusses the average values for the dependent variables as well as the average period differences. The average performance of the variables appears to decrease in Time-Lag 2 (e.g., Figures D7 – D12). The average period

[71] The second half growth rate is the percentage growth of the Cumulative Net Income Difference$_1$ from period 51 to period 100.
[72] DV stands for Demand Volatility.

difference (between the Always NFM and No NFM values) also appears to decrease. To understand if the averages actually do decrease, the non-financial dependent variables are now examined by comparing the first 50 period averages (periods 1 through 50) with the second 50 period averages (periods 51 through 100).

Both the Always NFM and No NFM decision frameworks are designed to control employee satisfaction and customer satisfaction so they equal a target value. Accordingly, the satisfaction measures have very narrow ranges over all conditions and this discussion focuses on the average differences for the first and last 50 periods.[73] When Time-Lag equals 0, the average differences for the first and second 50 periods are very close and the overall average difference is fairly representative. When Time-Lag equals 2, the average differences diverge and the overall average is not representative.

For example, focusing on employee satisfaction period differences, when NFM Measurement Error is present (Figure D23), the first 50 period average remains constant over the two Time-Lags, while the second 50 period average increases. This graph reinforces the above conclusion that when Time-Lag is longer the positive benefits of NFM usage eventually overcome the negative effects of NFM Measurement Error. For all other conditions (as represented by Figure D24), the first 50 period average decreases as Time-Lag grows longer, while the second 50 period average remains constant in Time-Lag 0 and Time-

[73] For the Always NFM decision framework, the average employee satisfaction measures range from 88.64 to 90.26 and the average customer satisfaction measures range from 88.07 to 89.95. For the No NFM decision framework, the average employee satisfaction measures range from 88 to 89.84 and the average customer satisfaction measures range from 87.19 to 89.55.

Lag 2. This pattern indicates that the longer the Time-Lag, the longer firms must wait to see the benefits of using NFMs.[74]

Figures D25 through D30 present the first and second 50 period average differences between the Always NFM and No NFM decision frameworks across the eight condition combinations for the remaining dependent variables. The profit margin, employee productivity, employee asset value, customer growth, and customer asset value differences are generally above zero, while employee turnover differences are generally less than zero. These results signify that the Always NFM decision framework is outperforming the No NFM decision framework. Moreover, the second 50 period differences are generally larger than the first 50 period differences indicating that the benefits of NFM usage increase over time.

The differences in Figures D25 and D30 may appear to be small, but the differences need to be interpreted in a meaningful way. For example, Figure D27 shows that the difference in employee productivity ranges from zero to 0.40 units per employee. If the company has 50,000 employees, employees complete as much as 20,000 units more during the period. In addition, the Always NFM Employee Asset Values are as much as $5,000 (per employee) larger than the No NFM Values (Figure D29). If the firm has 1,000 employees, this translates into a total incremental value of $5,000,000. Finally, the Always NFM Customer Asset Values, on the other hand, are only $25 (per customer) larger than the No NFM

[74] A similar pattern, decreasing 1st 50 period averages and constant 2nd 50 period averages, holds for the remaining dependent variables.

Values, but if the firm has 10,000 customers, the total incremental benefit of using NFMs is $250,000 (Figure D30).

4.3.2 Alternative Demand Volatility Levels

Several different Demand Volatility levels are also tested. Larger, positive Demand Volatility shocks increase the relative performance of the Always NFM decision framework compared to the No NFM decision framework. Larger negative shocks, however, may reduce the performance of the Always NFM decision framework below the performance of the No NFM decision framework. The reduction is due to the no layoff policy employed during the simulations. Specifically, when excess capacity is large, the system reduces the number of employees hired, but does not layoff employees. Since the No NFM decision framework generally has a higher employee turnover rate, the No NFM work force is smaller than the Always NFM work force. When there are large negative demand shocks, the Always NFM net income may drop below the No NFM net income because of the (unneeded) excess capacity.

4.3.3 Alternative Decision Frameworks

Chapter 3 presents the three decision frameworks used to generate the results – Always NFM, No NFM, and Intermittent NFM. The Always NFM is modeled on the incentive plan of an ECP firm that weights employee satisfaction, customer satisfaction, and net income equally (i.e., one-third employee satisfaction, one-third customer satisfaction, one-third net income) [Rucci, Kirn,

and Quinn, 1998]. To ensure that the simulation results are not due to the selected decision frameworks and their associated rules, several alternative decision frameworks are investigated. These alternative decision frameworks use the same target values and decision rules as the Always NFM and No NFM decision frameworks, but combine the information differently. The following alternative decision frameworks are examined:

1. *ES Only*: makes decisions based only on employee satisfaction.
2. *CS Only*: makes decisions based only on customer satisfaction.
3. *NFM Only*: makes decisions based on employee satisfaction and customer satisfaction weighted equally (i.e., ½ employee satisfaction, ½ customer satisfaction).
4. *Equal*: averages the NFM Only results with the FM decision framework results (i.e., ½ NFM Only, ½ FM).

To compare the performance of these decision frameworks, their Retained Earnings are compared to the No NFM Retained Earnings. Specifically, the average percent above the No NFM Retained Earnings is computed. Figures D31, D32, and D33 graph these average percentages for the four alternative decision frameworks as well as the Always NFM decision framework for Time-Lags 0, 1, and 2.

The graphs show that the decision frameworks generate higher results than the No NFM decision framework. The Equal decision framework appears to be

the best decision framework for decision-making because it generates 1.5 to 3.0 times the No NFM amounts. The NFM Only decision framework generates the second highest results, followed by the Always NFM, ES Only, and CS Only decision frameworks. Therefore, the results presented in this chapter using the Always NFM decision framework are conservative estimates of the overall effect of using NFMs in decision-making and would be larger if the Equal or NFM Only decision framework were used.

Some interesting conclusions about the NFM Only, CS Only, and ES Only decision frameworks can be made. The strong performance of the NFM Only decision framework is surprising because it outperforms the Always decision framework even in the presence of NFM Measurement Error. The graphs also show two important relations: (1) the NFM Only results are better than the ES Only and CS Only results; and (2) the ES Only decision framework outperforms the CS Only decision framework. Thus, controlling the beginning of a chain of NFMs is more profitable than controlling the end of the chain. And, to maximize net income, managers need to incorporate all relevant NFMs into the decision-making process.

4.3.4 Alternative Cutoff Values

The employee satisfaction, customer satisfaction and financial cutoff values used in the Always NFM and No NFM decision rules are also examined in a non-stochastic environment (No NFM Measurement Error, No Demand Volatility, no employee satisfaction and customer satisfaction shocks). Beginning

with the No NFM decision framework, the Retained Earnings in the Time-Lag 2 condition are larger if a different set of cutoff values are used. However, this set of cutoff values has a dramatic negative effect on the Time-Lag 0 and 1 results. Similarly, a Time-Lag of 3 periods requires a different set of cutoff values to maximize the Retained Earnings but these also have a negative effect on the Time-Lag 0, 1, and 2 results.

Turning to the Always NFM decision framework, using the best cutoff values from the Time-Lag 3 condition would negatively impact the results of the Time-Lag 0, 1, and 2 conditions. Moreover, as discussed in Chapter 3, to maximize firm profitability, customer satisfaction requires different satisfaction cutoff values than employee satisfaction. This differential explains why the ES Only decision framework outperforms the CS Only decision framework in Section 4.3.2. These results indicate that using FMs and NFMs to control firm performance is extremely difficult because the profit maximizing decision rules change as the Time-Lag changes.

4.4 SUMMARY OF THE RESULTS

This chapter summarizes the results of the simulations designed to examine the benefits of using NFMs in decision-making. The results indicate that benefits of using NFMs depend on a variety of factors including the operating environment, how managers are incorporating NFMs into decision-making, and how long the firm has been using NFMs.

This study focuses on three operating conditions – Time-Lag, NFM Measurement Error, and Demand Volatility. In a predictable (non-stochastic) environment with a short Time-Lag, using NFMs does not improve financial performance - the same financial results can be achieved either using FMs or NFMs in decision-making. As the Time-Lag grows longer, using NFMs greatly improves the firm's financial performance even in the non-stochastic environment. When demand is unpredictable, using NFMs increases firm performance because NFMs allow the firm to determine if demand changes are due to changes in more controllable factors, such as employee satisfaction and customer satisfaction, or due to changes in uncontrollable, external factors, such as a recession. On the other hand, NFM Measurement Error as well as employee satisfaction and customer satisfaction shocks reduce the benefits of using NFMs.

The method in which managers incorporate NFMs into decision-making also affects the benefits associated with NFMs. If managers incorporate NFMs infrequently into decision-making, i.e., the Intermittent NFM decision framework, financial performance is not significantly different than using FMs alone. To maximize performance, managers need to use NFMs consistently in decision-making with the appropriate target and cutoff values. These values are extremely difficult to determine and change as the firm's operating conditions change.

The manner in which managers combine the NFMs and FMs also affects the benefits. Managers need to incorporate all relevant NFMs and FMs. Sub-par results are achieved if managers only use part of the NFM chain, especially the end, to make decisions. Different relative weights on the individual NFMs and

FMs also change the benefits. In this simulation, the best method for incorporating NFMs into decision-making was the Equal decision framework, which equally weights NFMs and FMs in decision-making.

As the operating environment becomes more volatile, the length of time required to accrue the positive benefits of using NFMs increases. Time-Lag also increases the length of time required to see the positive effects of NFMs, but once attained, the positive financial results grow at an increasing rate. In fact, firms using NFMs may be initially disappointed with the results because operating and financial results decrease before rapidly increasing. When Time-Lag is longer, the benefits associated with NFMs may eventually overcome the negative impact of NFM Measurement Error and shocks. Thus, the longer the period of time that NFMs have been incorporated into decision-making, the higher the probability that the NFMs are positively influencing performance.

The last chapter, Chapter 5, presents a summary of the dissertation. It discusses the contributions of this study to existing literature as well as the implications of the results. The chapter concludes with limitations and suggestions for future research.

Chapter 5: Conclusion

5.1 OVERVIEW

This research's primary objective is to determine the costs and benefits of incorporating NFMs into managerial decision-making. To accomplish this goal, the study explores several distinct aspects of a model incorporating both NFMs and FMs into decision-making - the Employee-Customer-Profit chain model. The research first examines the pattern of the costs and benefits over an extended period of time. Second, the study investigates how the benefits change when NFMs are used with varying frequency (intermittently or consistently) in decision-making. Finally, the research analyzes how three different operating conditions, NFM-FM Time-Lag, NFM Measurement Error, and Demand Volatility, affect the costs and benefits of incorporating NFMs into managerial decision-making.

Section 5.2 discusses the contributions of the study to existing accounting literature, and Section 5.3 discusses the implications of the findings of this study for managerial accounting decision-making and empirical accounting research. The last section discusses the study's limitations, and provides suggestions for future research.

5.2 CONTRIBUTIONS TO EXISTING LITERATURE

The study utilizes a different methodology, system dynamics, to examine NFMs. This methodology allows the study to extend extant literature along

several dimensions. First, the study examines the impact of NFMs over a long time horizon. Second, a direct comparison of the impact of several conditions can be made because the methodology controls all operating conditions and isolates their impact. Therefore, the results can not be attributed to correlated omitted variables. Third, the study analyzes how varying Time-Lags change the results. Finally, the research examines how varying NFM measurement frequency and decision rules/frameworks affect the cost-benefit relation of NFMs.

The results give a richer understanding of why incorporating NFMs in decision-making sometimes improves firm performance and sometimes does not improve firm performance. In addition, the results give us insights into the mixed results of current empirical research studies. Using NFMs in decision-making can improve financial performance by improving the timing of expenditure decisions and reducing the variability of the operating environment. The impact, however, depends on a variety of factors including the operating environment, how managers are incorporating NFMs into decision-making, and how long the firm has been using NFMs.

In a predictable (non-stochastic) environment with a short Time-Lag, using NFMs does not improve financial performance - the same financial results can be achieved either using FMs or NFMs in decision-making. As the Time-Lag grows longer, using NFMs (eventually) improves the firm's financial performance. When demand is unpredictable, using NFMs increases firm performance because NFMs allow the firm to determine if demand changes are due to changes in controllable factors, such as employee satisfaction and customer

satisfaction, or due to changes in uncontrollable factors, such as a recession. On the other hand, measurement error as well as satisfaction shocks reduce the benefits of using NFMs.

The method in which managers incorporate NFMs into decision-making also affects the benefits associated with NFMs. If managers incorporate NFMs infrequently into decision-making financial performance is not significantly different than the financial performance generated by FMs alone. To maximize performance, managers need to use NFMs consistently in decision-making with the appropriate decision rules and incorporate all relevant NFMs and FMs. Different relative weights on the individual NFMs and FMs also change the benefits. In this simulation, the best method for incorporating NFMs into decision-making was the Equal decision framework, which equally weights the NFMs and FMs in decision-making.

As the operating environment becomes more volatile, the length of time required to accrue the positive benefits of using NFMs increases. A longer Time-Lag also increases the length of time required to see the positive effects of NFMs, but once attained, the positive financial results grow at an increasing rate. In fact, firms using NFMs may be initially disappointed with the results because operating and financial results decrease before rapidly increasing. When Time-Lag is longer, the benefits associated with NFM usage may eventually overcome the negative impact of NFM Measurement Error and shocks. Thus, the longer the period of time that NFMs have been incorporated into decision-making, the higher the probability that the NFMs are positively influencing performance.

5.3 IMPLICATIONS

The study offers two different types of insights. The first group is for managers using NFMs in decision-making. The second group is for researchers wishing to reconcile extant empirical accounting research results or conduct a new empirical study. The insights for managers are discussed first, followed by those for researchers.

Incorporating NFMs into the decision-making process does not ensure that firm profitability increases. Rather, this research shows that managers must carefully design their decision processes. To maximize profitability, managers need to first identify the entire NFM-FM chain and develop measures capturing all of its dimensions. The NFMs should contain minimal measurement error and need to be incorporated into the decision process on a frequent, not annual, basis. If the firm does not measure timely NFMs, managers will be forced to make decisions based solely on FMs, or on outdated NFMs, and not optimize firm performance.

Managers also need to understand the time relationship between non-financial factors and profits. Different relations require different decision rules. Moreover, the relationship needs to be constantly monitored so the NFMs and decision rules can be changed as the operating environment changes. Managers also need to determine the relative weights for the NFMs and FMs used in decision-making.

Finally, managers must have patience when using NFMs. This research indicates that the benefits of using NFMs may not be seen for several periods, or even years. The length of time required increases as Time-Lag and the volatility of the operating environment increases. The performance of the operating and financial variables may even initially decline before generating positive results that grow at very high rates.

The study also provides insights into the mixed results of empirical studies. Empirical studies are limited to the available data set. Based on the simulations, the results of an empirical study depend on what time period is studied. If an empirical study uses data from the time period when firms are beginning to integrate NFMs into the decision process, the study most likely will not find that NFM usage improves financial results. Studying a later time period should increase the likelihood that positive results will be found.

Empirical studies must also consider the operating environment and measurement error of the NFMs. A longer Time-Lag causes the payback period to increase but it is likely that NFMs will improve FMs. Similarly, demand volatility increases the probability that NFM usage will be beneficial. On the other hand, NFM measurement error and shocks can make NFM usage detrimental to the firm causing the firm to lose net income.

Researchers must also examine how firms are incorporating NFMs into decision-making. Firms that constantly measure and use all relevant NFMs are more likely to have a stronger relation between the NFMs and FMs. On the other hand, firms that infrequently measure NFMs and do not use all relevant NFMs are

more likely to have a weak relation between the NFMs and FMs. Therefore, the ability of researchers to capture the true relation between NFMs and FMs requires an understanding of the decision processes and environment of the firm.

5.4 LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

This study has three primary limitations as to conclusions and generalizability. The first limitation is that the ECP model is implemented with simulated data. Nevertheless, the data possess the characteristics of actual firm data and are used consistently across the decision frameworks to assess the relative effect of changing conditions. The second limitation is inherent in the simulation methodology. Specifically, simplifying assumptions must be made to simulate the ECP model. While I attempt to make the assumptions mirror the real world conditions, assumptions must be made that simplify real world phenomenon. However, this disadvantage is also an advantage in that the simplified world allows three key conditions to be isolated and examined. A thorough understanding of a simplified world is necessary before adding additional complexities to the model.

The third limitation is that only one business model, enterprise relationship management, is studied. This model, however, is becoming increasingly important as business becomes more competitive, employee tenure decreases (draining intellectual capital from the firm), and customer power increases. Given this environment, a growing number of firms are attempting to

manage employee and customer satisfaction to maximize profitability.[75] The paper provides a starting point for additional research in this area. Future research can examine whether the results generalize to other NFMs and business models.

[75] This claim is supported by the following statement: "At many companies, the human factor – employees' knowledge, skill and ability to innovate and serve customers – has overtaken the bricks-and mortar assets of the Industrial Age as the biggest driver of profit. Employers are scrambling to figure out what kinds of investments in people pay off: in reduced quit rates, more satisfied employees, better customer satisfaction and profit" [Shellenbarger, 2000, B1].

Appendix A: *ithink* Employee-Customer-Profit Chain Model

Appendix A presents the *ithink* model of the Employee-Customer-Profit chain (ECP). The ECP model is divided into the following 5 sections:

1. *Decision-Making*: logic determining the Employee Support Expenditure choice by the Always NFM, No NFM, and Intermittent NFM decision framework
2. *Employee*: logic determining the employee satisfaction level and number of employees
3. *Customer*: logic determining the customer satisfaction level and number of customers
4. *Process*: logic determining the number of units produced during the period
5. *Financial*: logic calculating the financial results

Figure A1: Decision-Making Sector

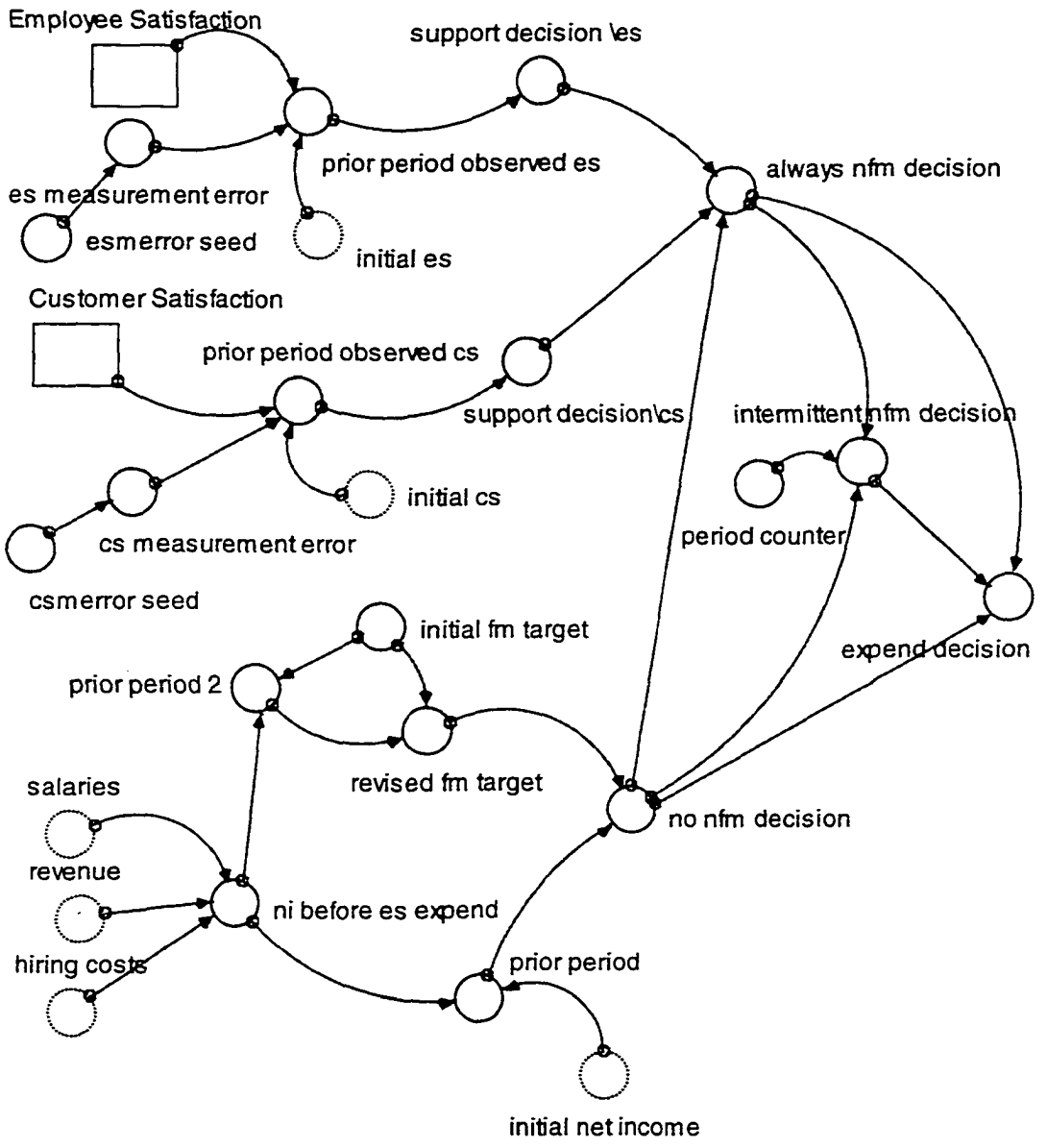


Figure A2: Employee Sector

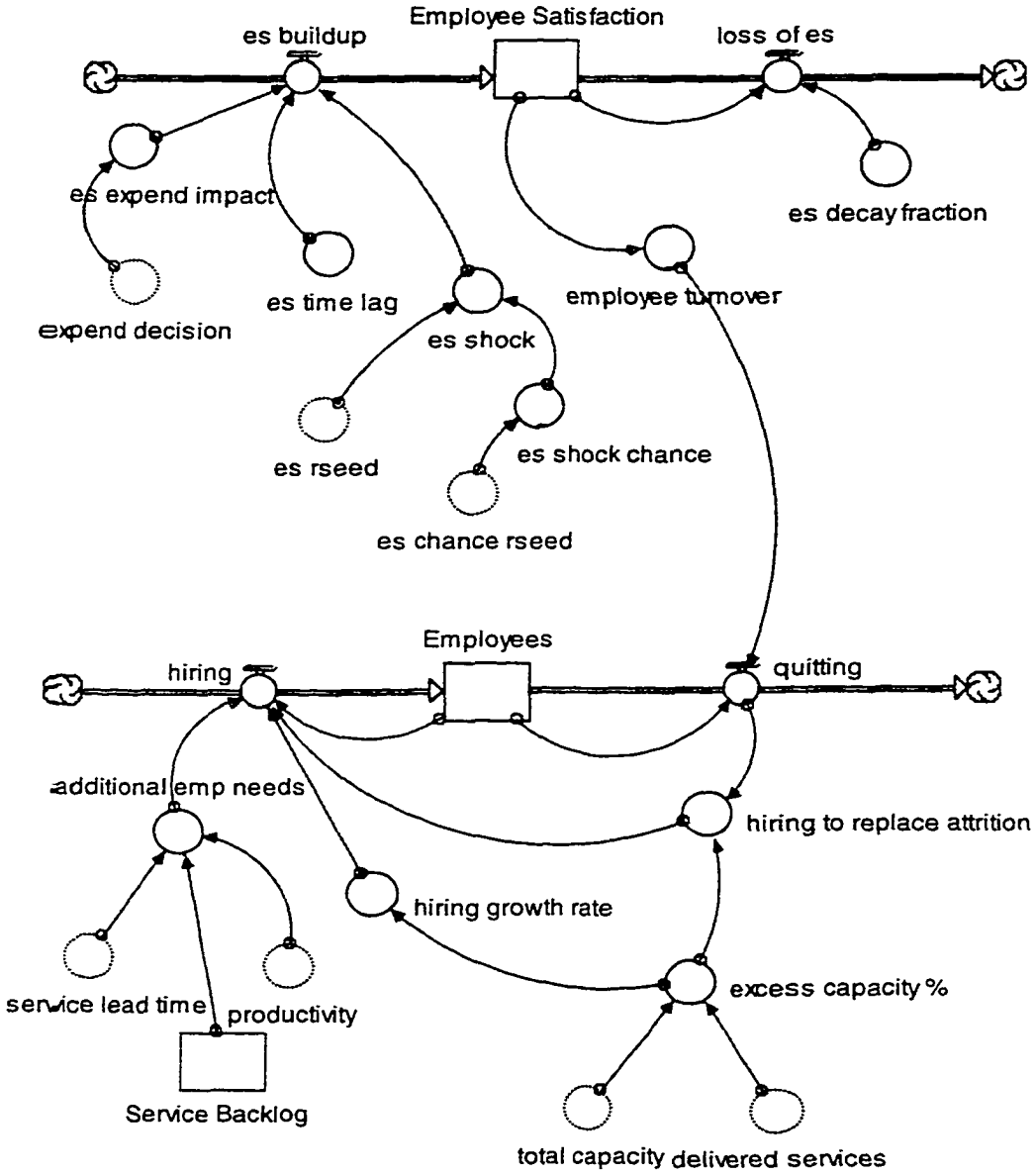


Figure A3: Customer Sector

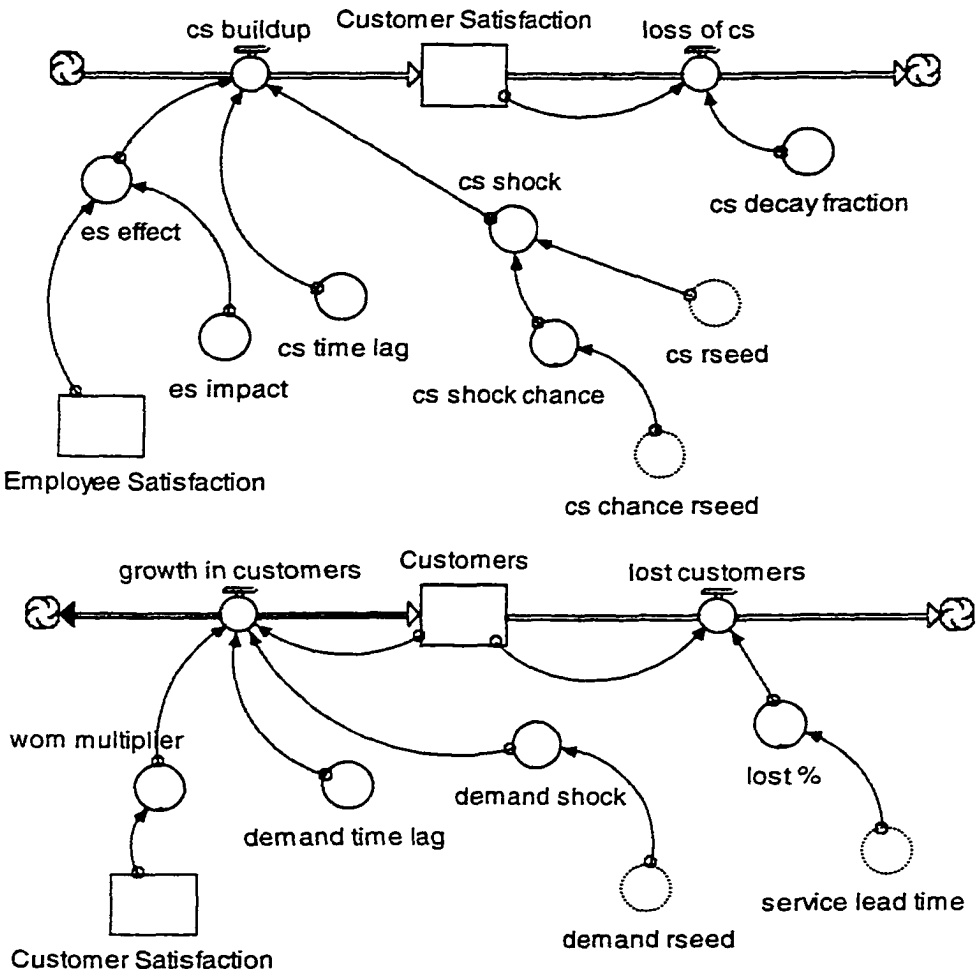


Figure A4: Process Sector

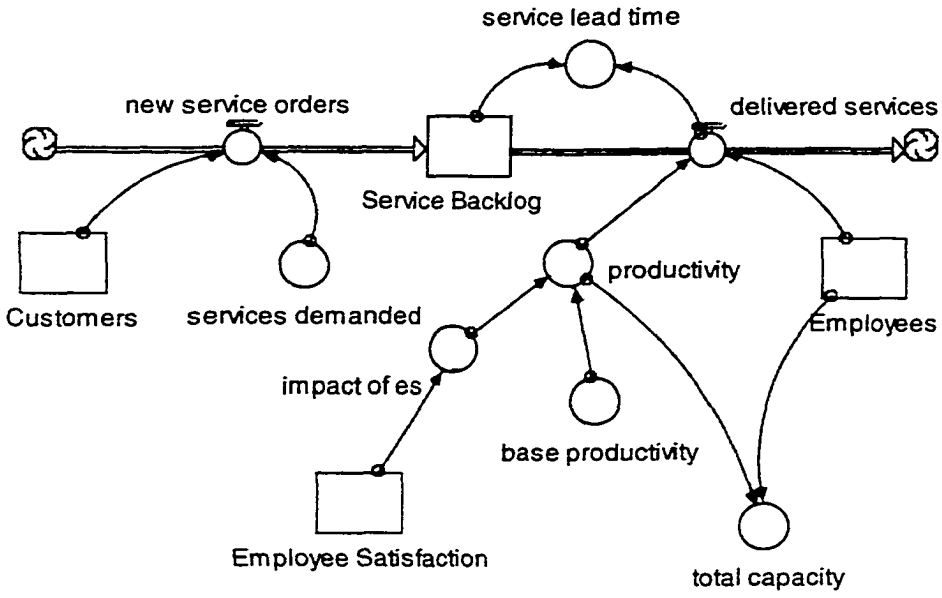
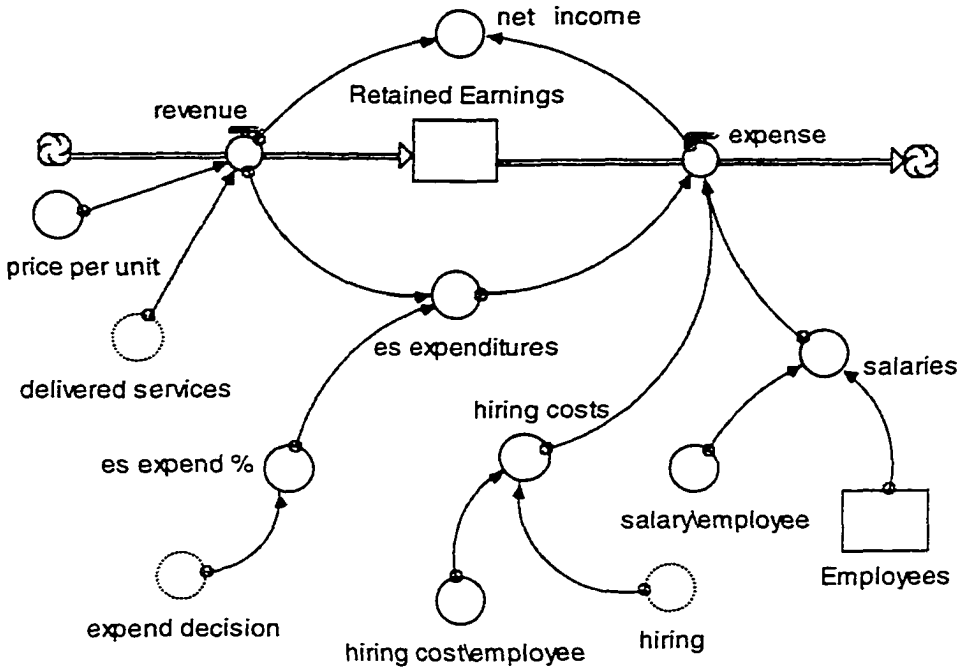


Figure A5: Financial Sector

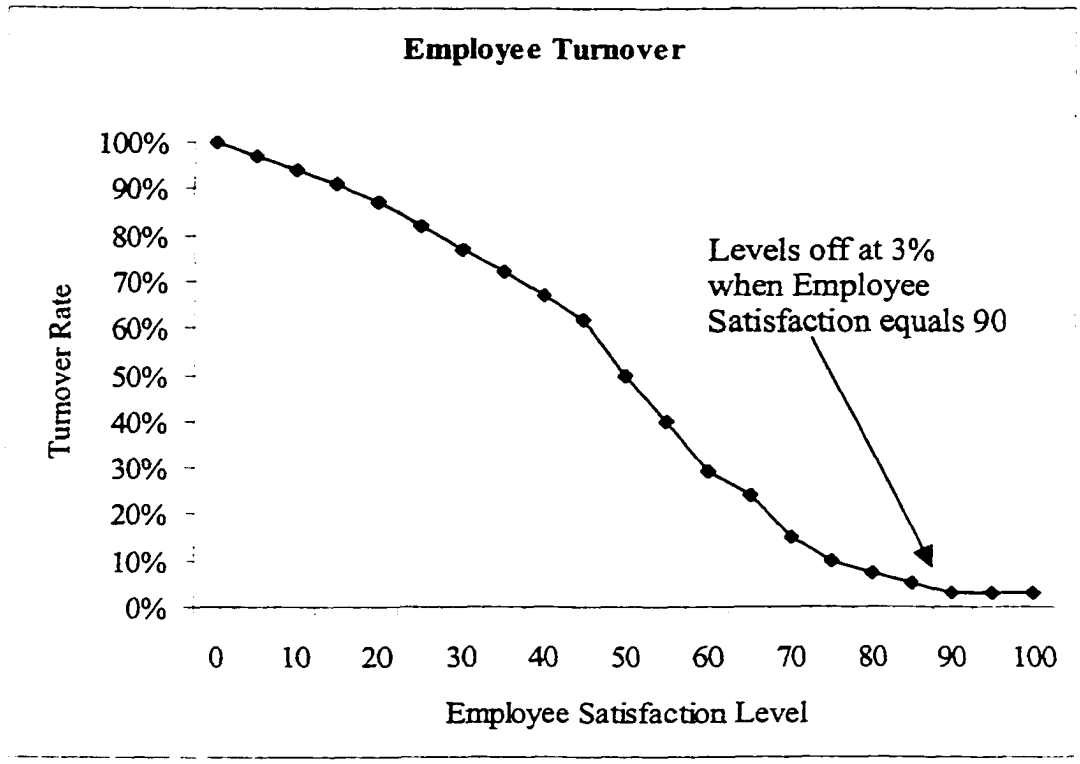


Appendix B: *ithink* Graphs

Appendix B presents the graphs contained in the *ithink* ECP model presented in Appendix A. The following four graphs are included in the *ithink* model:

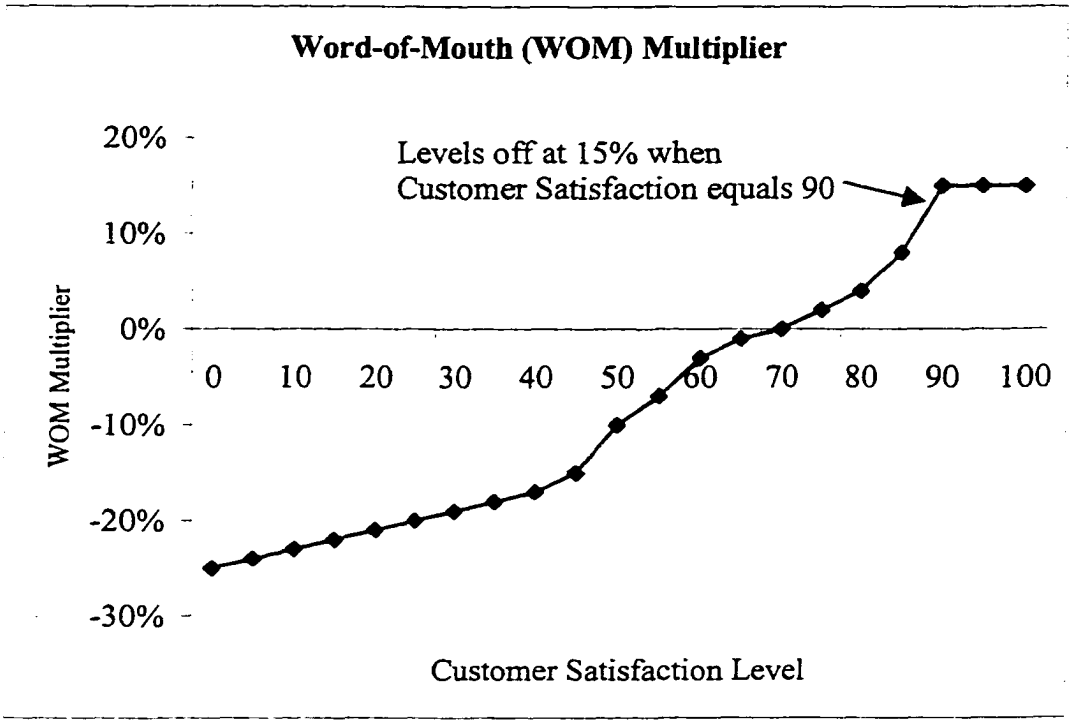
1. Employee Turnover: number of employees leaving the firm
2. Word-of-Mouth Multiplier: customer satisfaction affect on demand
3. Percent of Customers Lost (lost % converter): number of customers not repurchasing due to service lead times
4. Productivity Curve (impact of es converter): impact of employee satisfaction affect on employee productivity

Figure B1: Employee Turnover[76]



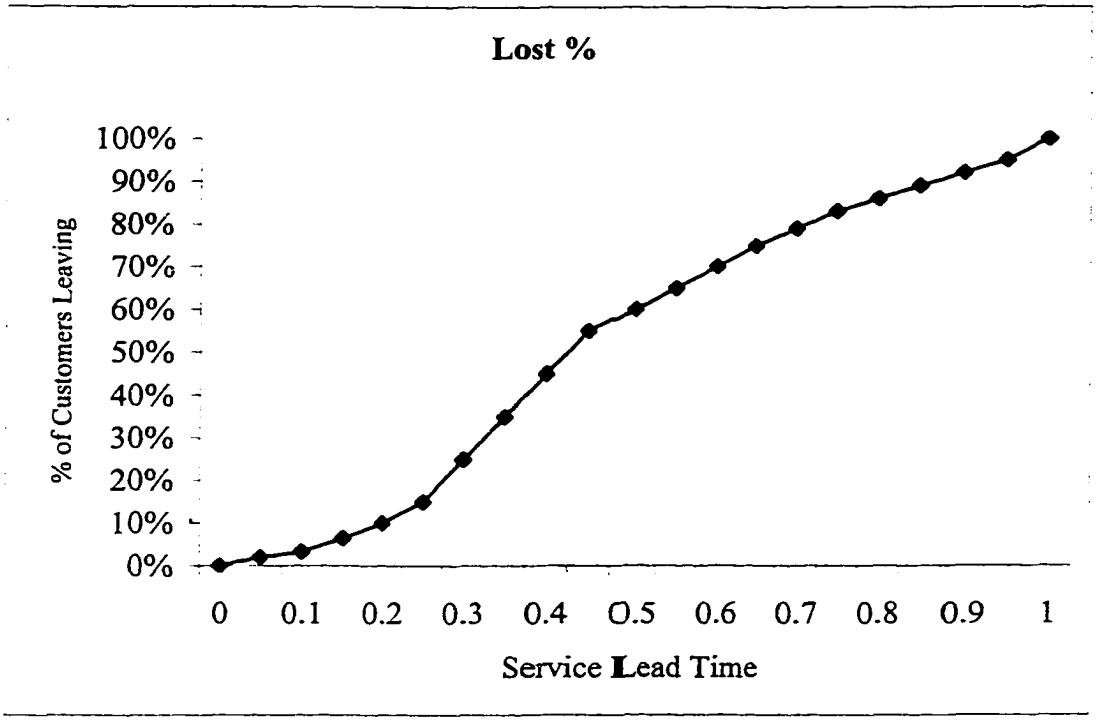
[76] Employee turnover is the percent of employees leaving the firm during the period due to employee satisfaction levels.

Figure B2: Word-of-Mouth (WOM) Multiplier[77]



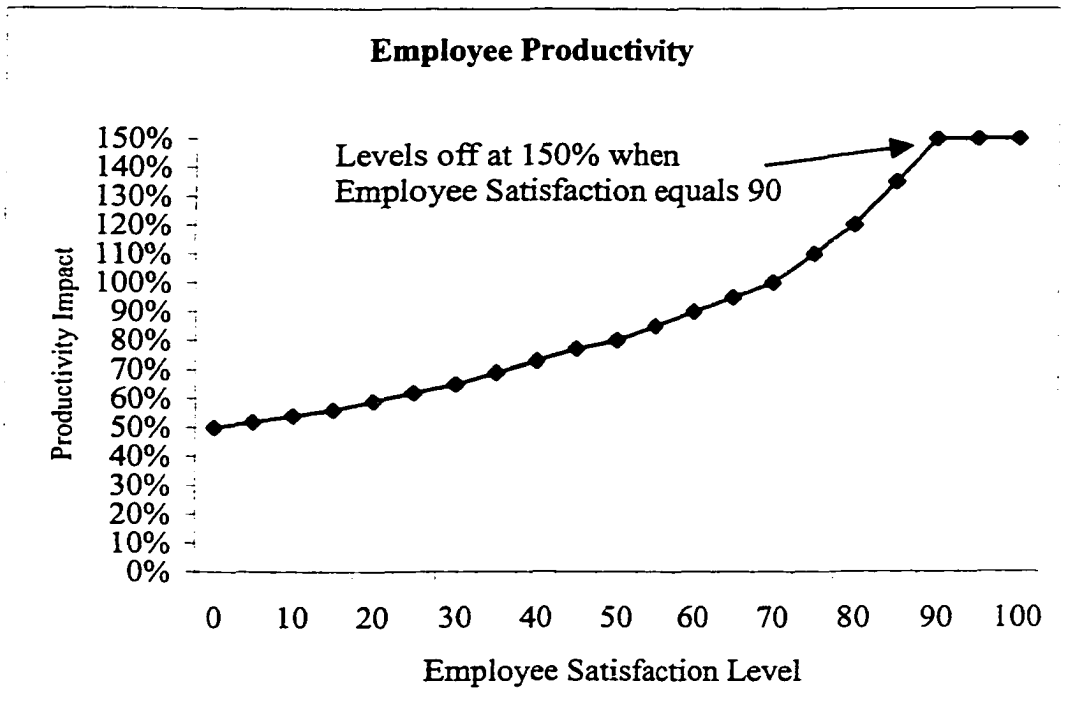
[77] Word-of-Mouth Multiplier is the impact of customer satisfaction on demand during the period.

Figure B3: Percent of Customers Lost (lost % converter)[78]



[78] Lost % is the percent of customers leaving the firm during the period due to service lead time.

Figure B4: Productivity Curve (impact of es converter)[79]



[79] The productivity curve is the impact of employee satisfaction on the number of units an employee finishes during the period.

Appendix C: *ithink* Employee-Customer-Profit Chain Model Equations

Appendix C presents the equations underlying the *ithink* model of the Employee-Customer-Profit chain (ECP). Similar to Appendix A, the ECP model is divided into the following 5 sections:

1. *Decision-Making*: logic determining the Employee Support Expenditure choice by the Always NFM, No NFM, and Intermittent NFM decision framework
2. *Employee*: logic determining the employee satisfaction level and number of employees
3. *Customer*: logic determining the customer satisfaction level and number of customers
4. *Process*: logic determining the number of units produced during the period
5. *Financial*: logic calculating the financial results

Customers(t) = Customers(t - dt) + (growth_in_customers - lost_customers) * dt
INIT Customers = 5500
growth_in_customers = DELAY(wom_multiplier,demand_time_lag)*Customers
+ Customers*demand_shock
lost_customers = ROUND(Customers*lost_%)
Customer_Satisfaction(t) = Customer_Satisfaction(t - dt) + (cs_buildup -
loss_of_cs) * dt
INIT Customer_Satisfaction = 75
cs_buildup = DELAY(es_effect,cs_time_lag) + cs_shock
loss_of_cs = Customer_Satisfaction*cs_decay_fraction
cs_decay_fraction = .55
cs_shock = NORMAL(0,5,cs_rseed) * cs_shock_chance
cs_time_lag = 1
demand_shock = NORMAL(0,.05,demand_rseed)
demand_time_lag = 1
es_effect = Employee_Satisfaction*es_impact
es_impact = .55
cs_shock_chance = GRAPH(RANDOM(0,1,cs_chance_rseed))
(0.00, 0.00), (0.1, 1.00), (0.2, 0.00), (0.3, 0.00), (0.4, 0.00), (0.5, 0.00), (0.6, 0.00),
(0.7, 0.00), (0.8, 0.00), (0.9, 0.00), (1, 0.00)
lost_% = GRAPH(service_lead_time)
(0.00, 0.00), (0.05, 0.02), (0.1, 0.033), (0.15, 0.064), (0.2, 0.1), (0.25, 0.15), (0.3,
0.25), (0.35, 0.35), (0.4, 0.45), (0.45, 0.55), (0.5, 0.6), (0.55, 0.65), (0.6, 0.7),
(0.65, 0.75), (0.7, 0.79), (0.75, 0.83), (0.8, 0.86), (0.85, 0.89), (0.9, 0.92), (0.95,
0.95), (1.00, 1.00)
wom_multiplier = GRAPH(Customer_Satisfaction)
(0.00, -0.25), (5.00, -0.24), (10.0, -0.23), (15.0, -0.22), (20.0, -0.21), (25.0, -0.2),
(30.0, -0.19), (35.0, -0.18), (40.0, -0.17), (45.0, -0.15), (50.0, -0.1), (55.0, -0.07),
(60.0, -0.03), (65.0, -0.01), (70.0, 0.00), (75.0, 0.02), (80.0, 0.04), (85.0, 0.08),
(90.0, 0.15), (95.0, 0.15), (100, 0.15)
always_nfm_decision =
ROUND((support_decision\cs+support_decision_\es+no_nfm_decision)/3)
csmerror_seed = 6
cs_measurement_error = NORMAL(0,5,csmerror_seed)
esmerror_seed = 5
es_measurement_error = NORMAL(0,5,esmerror_seed)
expend_decision = (always_nfm_decision *1)+ (intermittent_nfm_decision *0) +
(no_nfm_decision *0)
initial_fm_target = 700000
intermittent_nfm_decision = IF(period_counter=4) THEN always_nfm_decision
ELSE no_nfm_decision
ni_before_es_expend = revenue-hiring_costs-salaries

```
no_nfm_decision = IF(prior_period >=  (revised_fm_target*1.05)) THEN 1 ELSE
IF(prior_period <= (revised_fm_target * .94))  THEN 3 ELSE
2
period_counter = COUNTER(1,5)
prior_period =  DELAY( (ni_before_es_expend),1,initial_net_income)
prior_period_2 = DELAY(ni_before_es_expend,2,initial_fm_target)
prior_period_observed_cs =
DELAY(Customer_Satisfaction,1,initial_cs)+cs_measurement_error
prior_period_observed_es = DELAY(Employee_Satisfaction,1,initial_es)
+es_measurement_error
revised_fm_target = IF(prior_period_2>initial_fm_target) THEN
prior_period_2*1.15
ELSE initial_fm_target*1.15
support_decision\cs = IF(prior_period_observed_cs <83) THEN 3
ELSE IF(prior_period_observed_cs > 96) THEN 1
ELSE 2
support_decision_\es = IF(prior_period_observed_es <89) THEN 3
ELSE IF(prior_period_observed_es > 96) THEN 1
ELSE 2
Employees(t) = Employees(t - dt) + (hiring - quitting) * dt
INIT Employees = 1000
hiring = ROUND((hiring_growth_rate * Employees) + hiring_to_replace_attrition
+ additional_emp_needs)
quitting = ROUND(Employees*employee_turnover)
Employee_Satisfaction(t) = Employee_Satisfaction(t - dt) + (es_buildup -
loss_of_es) * dt
INIT Employee_Satisfaction = 75
es_buildup = DELAY(es_expend_impact,es_time_lag,0) +es_shock
loss_of_es = Employee_Satisfaction*es_decay_fraction
additional_emp_needs = IF(service_lead_time >= .10) THEN
ROUND(Service_Backlog/productivity * .5) ELSE 0
es_decay_fraction = .2
es_expend_impact =  IF(expend_decision=1) THEN 15 ELSE
 IF(expend_decision=2) THEN 18 ELSE
 IF(expend_decision=3) THEN 20  ELSE 0
es_shock = es_shock_chance *NORMAL(0,5,es_rseed)
es_time_lag = 1
excess_capacity_% = (total_capacity-delivered_services)/delivered_services
hiring_growth_rate = IF(excess_capacity_% < .10) THEN .15 ELSE 0
hiring_to_replace_attrition = IF(excess_capacity_% < .10) THEN quitting ELSE
0
```

employee_turnover = GRAPH(Employee_Satisfaction)
(0.00, 1.00), (5.00, 0.97), (10.0, 0.94), (15.0, 0.91), (20.0, 0.87), (25.0, 0.82), (30.0, 0.77), (35.0, 0.72), (40.0, 0.67), (45.0, 0.62), (50.0, 0.5), (55.0, 0.4), (60.0, 0.29), (65.0, 0.24), (70.0, 0.15), (75.0, 0.1), (80.0, 0.075), (85.0, 0.05), (90.0, 0.03), (95.0, 0.03), (100, 0.03)
es_shock_chance = GRAPH(RANDOM(0,1,es_chance_rseed))
(0.00, 0.00), (0.1, 1.00), (0.2, 0.00), (0.3, 0.00), (0.4, 0.00), (0.5, 0.00), (0.6, 0.00), (0.7, 0.00), (0.8, 0.00), (0.9, 0.00), (1, 0.00)
Retained_Earnings(t) = Retained_Earnings(t - dt) + (revenue - expense) * dt
INIT Retained_Earnings = 0
revenue = delivered_services*price_per_unit
expense = salaries + hiring_costs + es_expenditures
es_expenditures = revenue * es_expend_%
es_expend_% = IF(expend_decision=1) THEN .01 ELSE
IF(expend_decision=2) THEN .05 ELSE
IF(expend_decision=3) THEN .10 ELSE 0
hiring_costs = hiring * (hiring_cost\employee)
hiring_cost\employee = 225
net___income = revenue-expense
price_per_unit = 100
salaries = (Employees) * (salary\employee)
salary\employee = 450
Service_Backlog(t) = Service_Backlog(t - dt) + (new_service_orders - delivered_services) * dt
INIT Service_Backlog = 0
new_service_orders = ROUND(Customers*services_demanded)
delivered_services = ROUND(Employees*productivity)
base_productivity = 10
productivity = base_productivity*impact_of_es
services_demanded = 2
service_lead_time = Service_Backlog/delivered_services
total_capacity = Employees*productivity
impact_of_es = GRAPH(Employee_Satisfaction)
(0.00, 0.5), (5.00, 0.52), (10.0, 0.54), (15.0, 0.56), (20.0, 0.59), (25.0, 0.62), (30.0, 0.65), (35.0, 0.69), (40.0, 0.73), (45.0, 0.77), (50.0, 0.8), (55.0, 0.85), (60.0, 0.9), (65.0, 0.95), (70.0, 1.00), (75.0, 1.10), (80.0, 1.20), (85.0, 1.35), (90.0, 1.50), (95.0, 1.50), (100, 1.50)
initial_cs = 75
initial_es = 75
initial_net_income = 650000

Appendix D: Simulation Graphs

Appendix D presents graphs of the simulation results. Each graph shows the average value generated by 15 simulation runs. The following notation is used throughout the graphs:

Decision Framework

Always NFM:	uses NFMs and FMs to make Employee Support Expenditure decisions.
No NFM:	uses only FMs to make Employee Support Expenditure decisions.
Intermittent NFM:	supplements the FMs with NFMs every fourth period to make Employee Support Expenditure decisions.

Operating Condition

Time-Lag:	identifies the length of time that it takes for the NFM factors to affect other NFM and/or FM factors (e.g., how long each Employee-Customer-Profit chain link takes to affect the next link).
NFM Measurement Error:	identifies the presence of measurement error in the employee satisfaction and customer satisfaction measures.
Demand Volatility:	indicates that demand is not completely determined by the customer satisfaction level.

Shocks:	Indicates the presence of employee satisfaction and customer satisfaction shocks, which are unpredictable and uncontrollable.

The graphs also identify the combination of conditions using the following numbers:

Condition

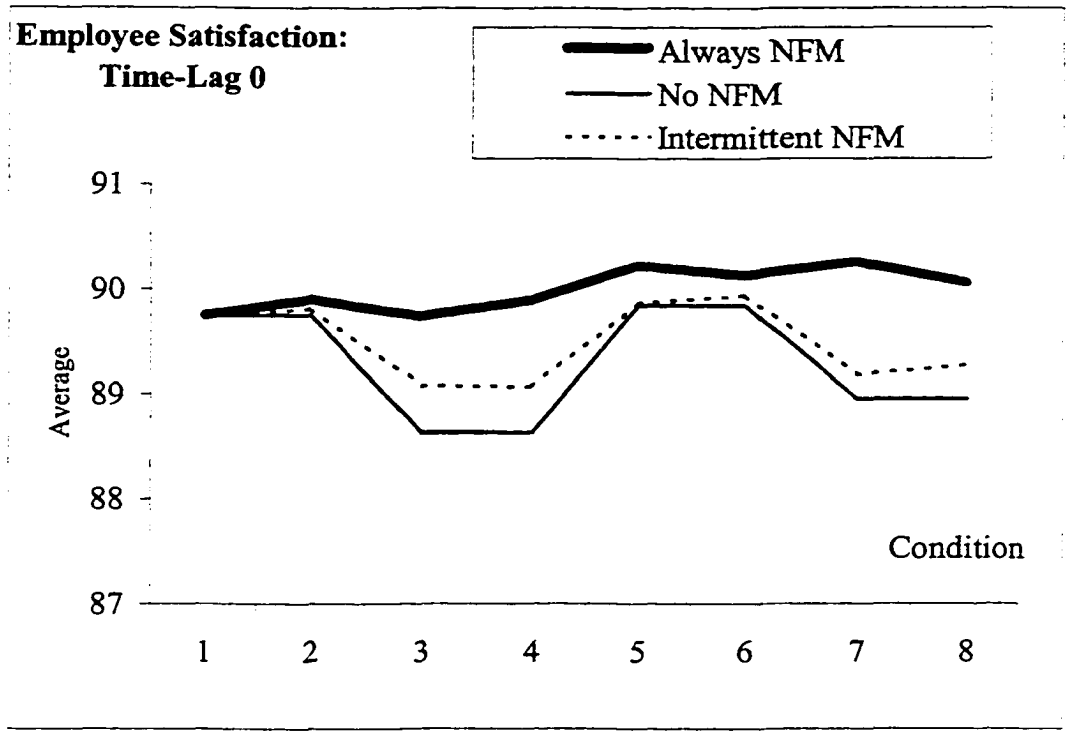
1:	Base, Non-stochastic condition
2:	NFM Measurement Error
3:	(High) Demand Volatility
4:	NFM Measurement Error, Demand Volatility
5:	Employee Satisfaction and Customer Satisfaction Shocks
6:	Shocks, NFM Measurement Error
7:	Shocks, (High) Demand Volatility
8:	Shocks, NFM Measurement Error, (High) Demand Volatility

Other notation used in the figures:

Period:	indicates a specific simulation period (i.e., period 15).
Period Difference:	The difference between the Always NFM and No NFM during a period.
Average Period Difference:	The average of the 100 Period Differences.

Overall Standard Deviation:	The average standard deviation over the 100 period simulation horizon. First, the standard deviation of each 100 period simulation run is calculated. Then, the average of the 15 standard deviations is computed to determine the Overall Standard Deviation.
Within Period Standard Deviation:	The average standard deviation within a period. First, the standard deviation of the 15 simulation runs in one period is calculated, yielding 100 standard deviations. Then, the average of those 100 standard deviations is computed to determine the Within Period Standard Deviation.

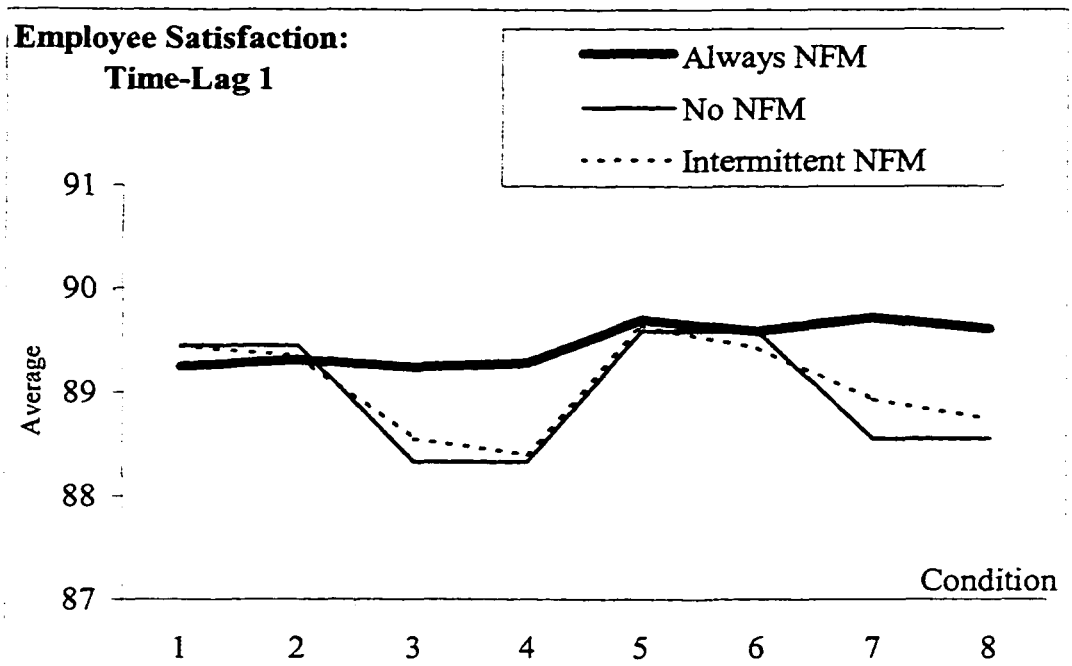
Figure D1: Average Employee Satisfaction Level: Time-Lag 0[80]



[80] The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures, while the Intermittent NFM decision framework supplements the financial measures with non-financial measures every fourth period. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. Condition identifies the studied conditions and is defined as follows:

1: Base, Non-stochastic Case
2: NFM Measurement Error
3: High Demand Volatility
4: NFM Measurement Error, High Demand Volatility
5: (Employee Satisfaction and Customer Satisfaction) Shocks
6: Shocks, NFM Measurement Error
7: Shocks, High Demand Volatility
8: Shocks, NFM Measurement Error, High Demand Volatility

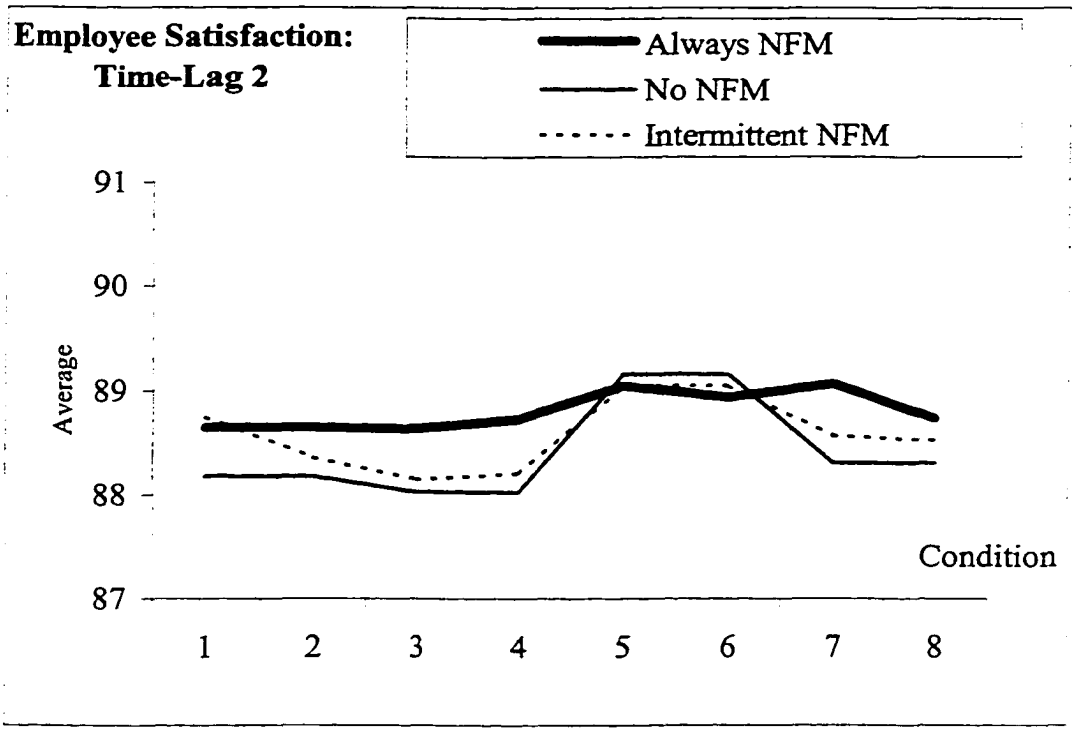
Figure D2: Average Employee Satisfaction Level: Time-Lag 1[81]



[81] The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures, while the Intermittent NFM decision framework supplements the financial measures with non-financial measures every fourth period. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. Condition identifies the studied conditions and is defined as follows:

1: Base, Non-stochastic Case
2: NFM Measurement Error
3: High Demand Volatility
4: NFM Measurement Error, High Demand Volatility
5: (Employee Satisfaction and Customer Satisfaction) Shocks
6: Shocks, NFM Measurement Error
7: Shocks, High Demand Volatility
8: Shocks, NFM Measurement Error, High Demand Volatility

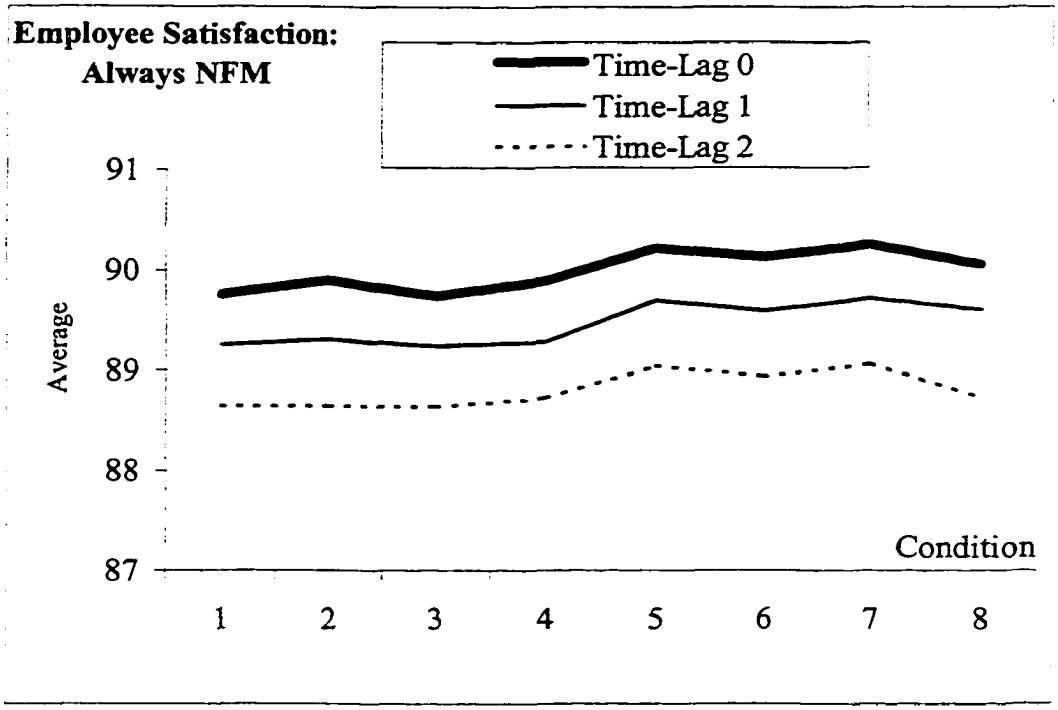
Figure D3: Average Employee Satisfaction Level: Time-Lag 2[82]



[82] The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures, while the Intermittent NFM decision framework supplements the financial measures with non-financial measures every fourth period. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. Condition identifies the studied conditions and is defined as follows:

1: Base, Non-stochastic Case
2: NFM Measurement Error
3: High Demand Volatility
4: NFM Measurement Error, High Demand Volatility
5: (Employee Satisfaction and Customer Satisfaction) Shocks
6: Shocks, NFM Measurement Error
7: Shocks, High Demand Volatility
8: Shocks, NFM Measurement Error, High Demand Volatility

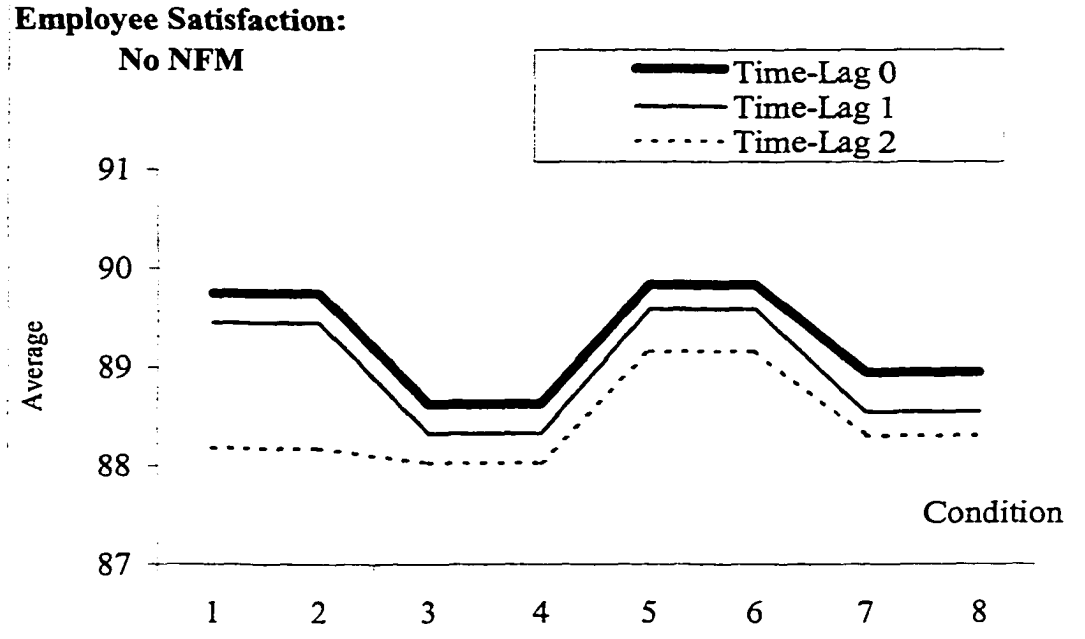
Figure D4: Average Employee Satisfaction Level: Always NFM[83]



[83] The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures, while the Intermittent NFM decision framework supplements the financial measures with non-financial measures every fourth period. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. Condition identifies the studied conditions and is defined as follows:

1: Base, Non-stochastic Case
2: NFM Measurement Error
3: High Demand Volatility
4: NFM Measurement Error, High Demand Volatility
5: (Employee Satisfaction and Customer Satisfaction) Shocks
6: Shocks, NFM Measurement Error
7: Shocks, High Demand Volatility
8: Shocks, NFM Measurement Error, High Demand Volatility

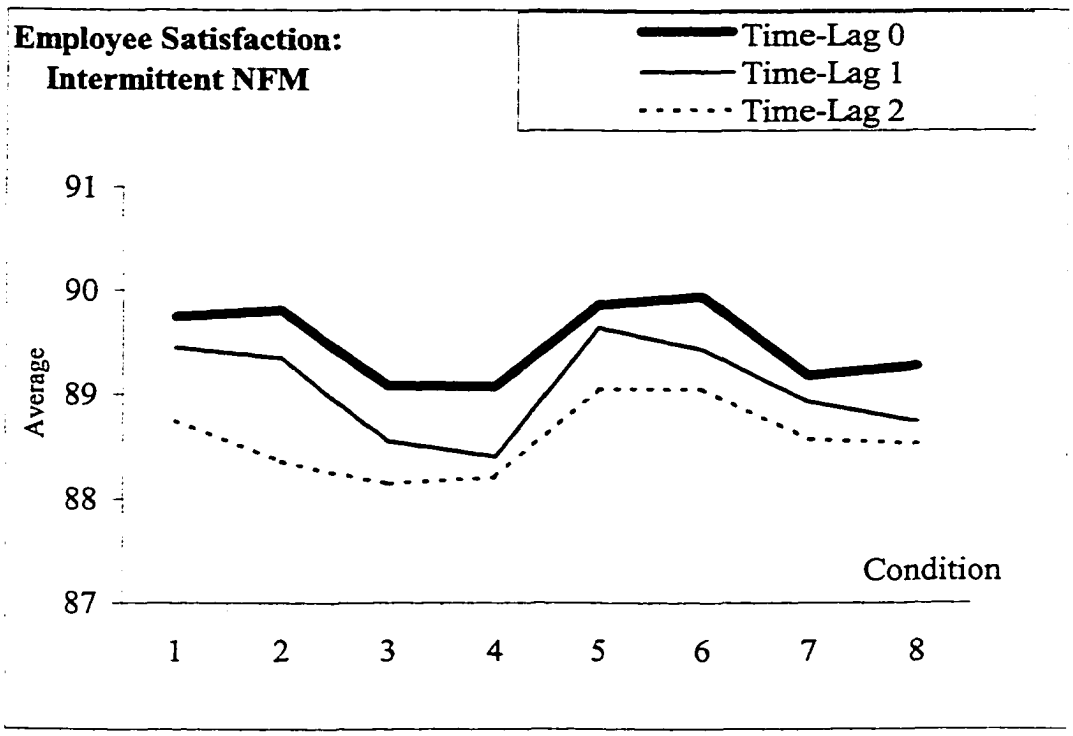
Figure D5: Average Employee Satisfaction Level: No NFM[84]



[84] The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures, while the Intermittent NFM decision framework supplements the financial measures with non-financial measures every fourth period. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. Condition identifies the studied conditions and is defined as follows:

1: Base, Non-stochastic Case
2: NFM Measurement Error
3: High Demand Volatility
4: NFM Measurement Error, High Demand Volatility
5: (Employee Satisfaction and Customer Satisfaction) Shocks
6: Shocks, NFM Measurement Error
7: Shocks, High Demand Volatility
8: Shocks, NFM Measurement Error, High Demand Volatility

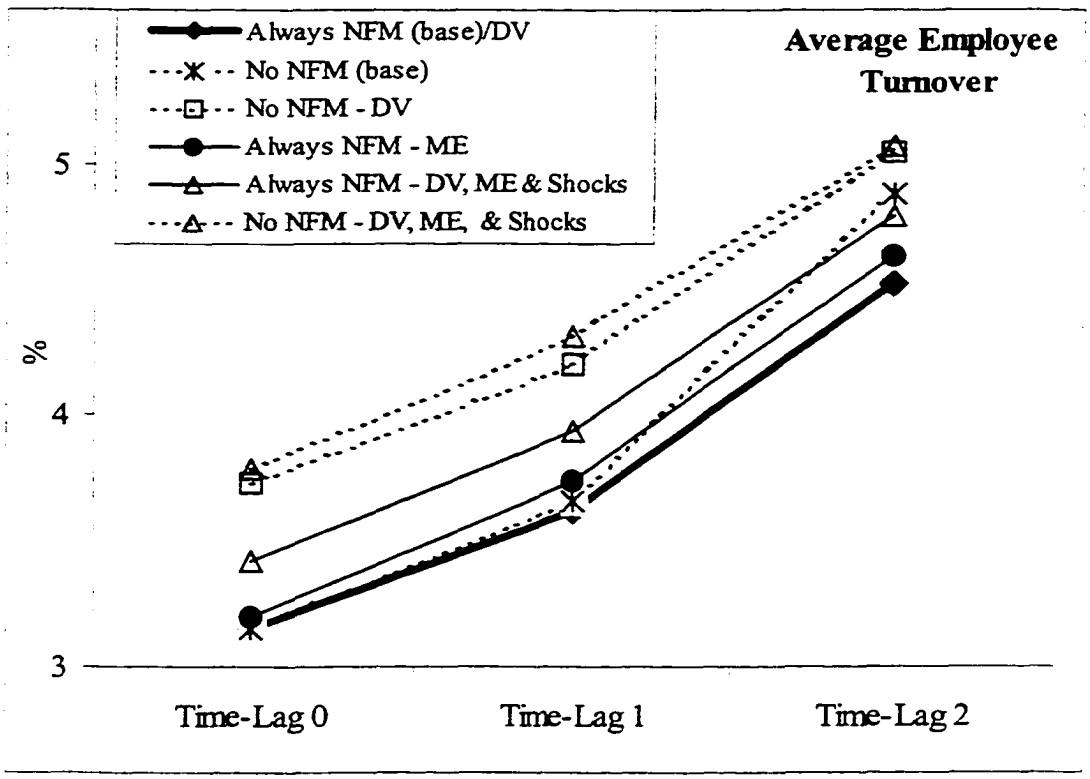
Figure D6: Average Employee Satisfaction Level: Intermittent NFM[85]



[85] The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures, while the Intermittent NFM decision framework supplements the financial measures with non-financial measures every fourth period. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. Condition identifies the studied conditions and is defined as follows:

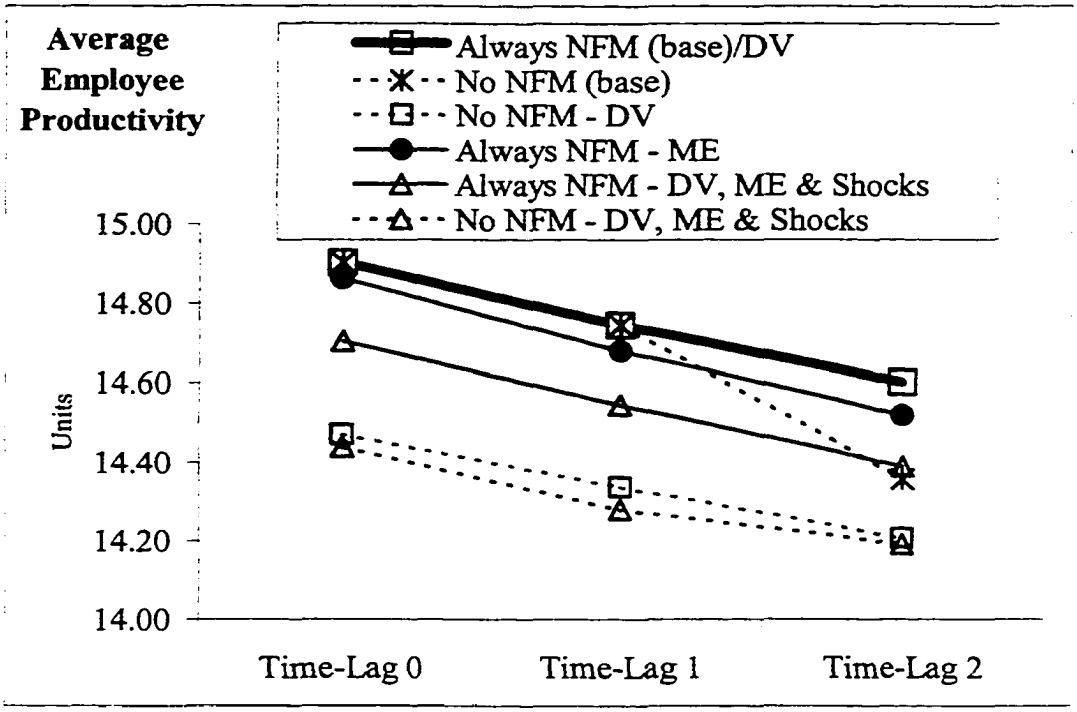
1: Base, Non-stochastic Case
2: NFM Measurement Error
3: High Demand Volatility
4: NFM Measurement Error, High Demand Volatility
5: (Employee Satisfaction and Customer Satisfaction) Shocks
6: Shocks, NFM Measurement Error
7: Shocks, High Demand Volatility
8: Shocks, NFM Measurement Error, High Demand Volatility

Figure D7: Average Employee Turnover[86]



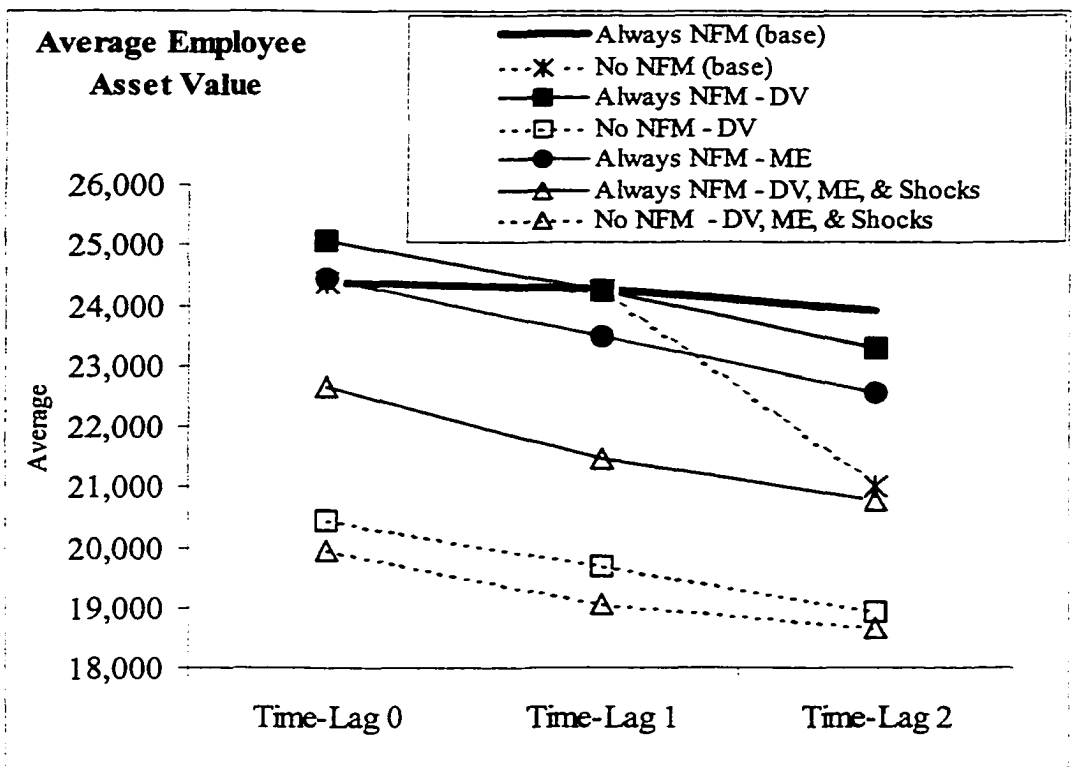
[86] Average Employee Turnover is the average turnover rate during the 100 period simulation. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. DV, ME, and shocks refer to Demand Volatility, NFM Measurement Error, and random employee satisfaction and customer satisfaction shocks, respectively.

Figure D8: Average Employee Productivity[87]



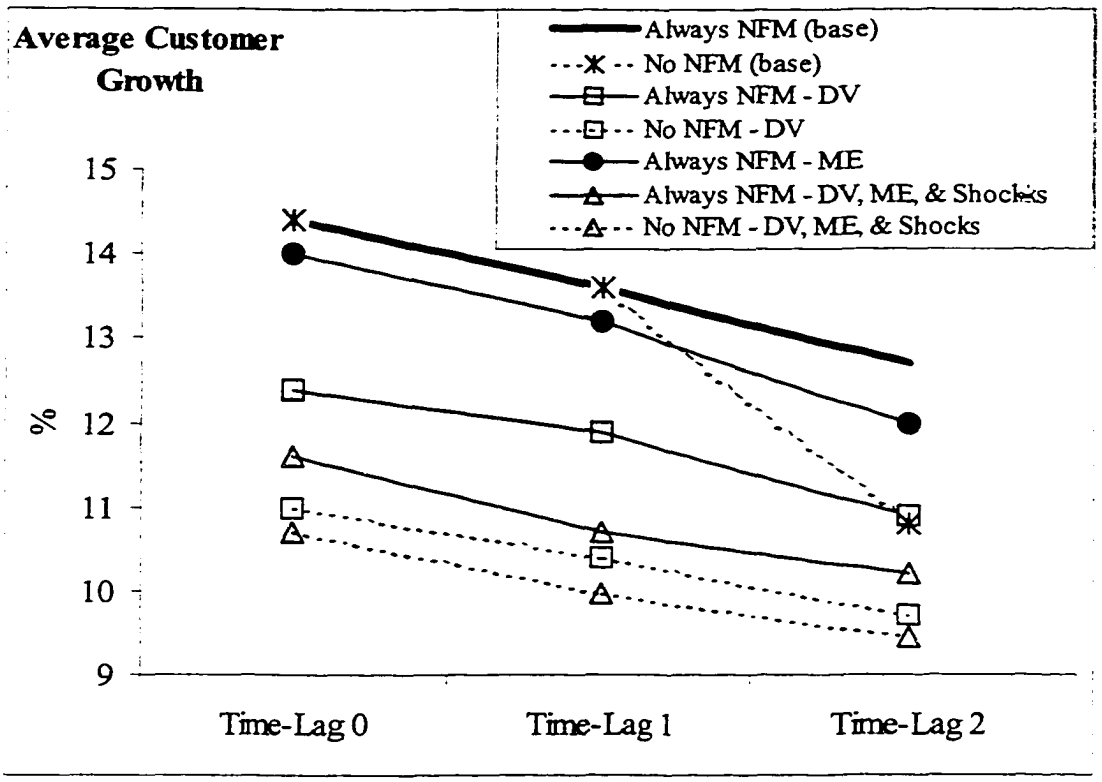
[87] Average Employee Productivity is the average number of units produced during a period over the (100 period) simulation. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. DV, ME, and shocks refer to Demand Volatility, NFM Measurement Error, and random employee satisfaction and customer satisfaction shocks, respectively.

Figure D9: Average Employee Asset Value[88]



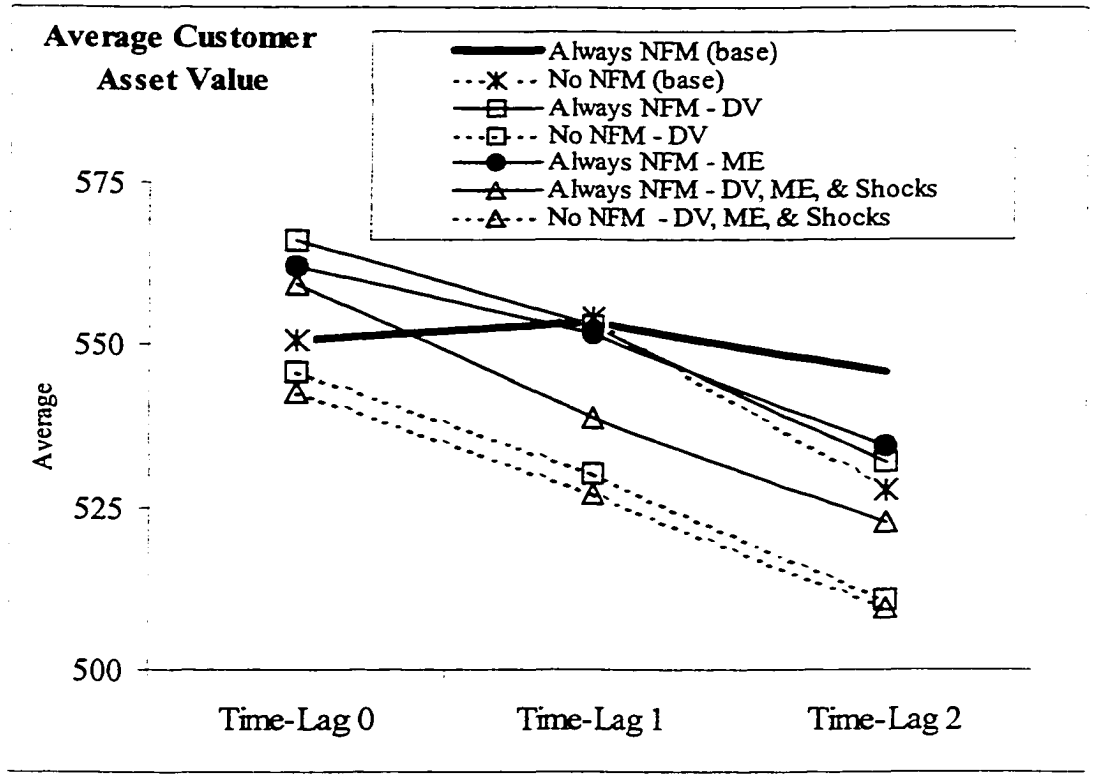
[88] Average Employee Asset Value is the average value of employees to the firm during a period over the (100 period) simulation. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. DV, ME, and shocks refer to Demand Volatility, NFM Measurement Error, and random employee satisfaction and customer satisfaction shocks, respectively.

Figure D10: Average Customer Growth[89]



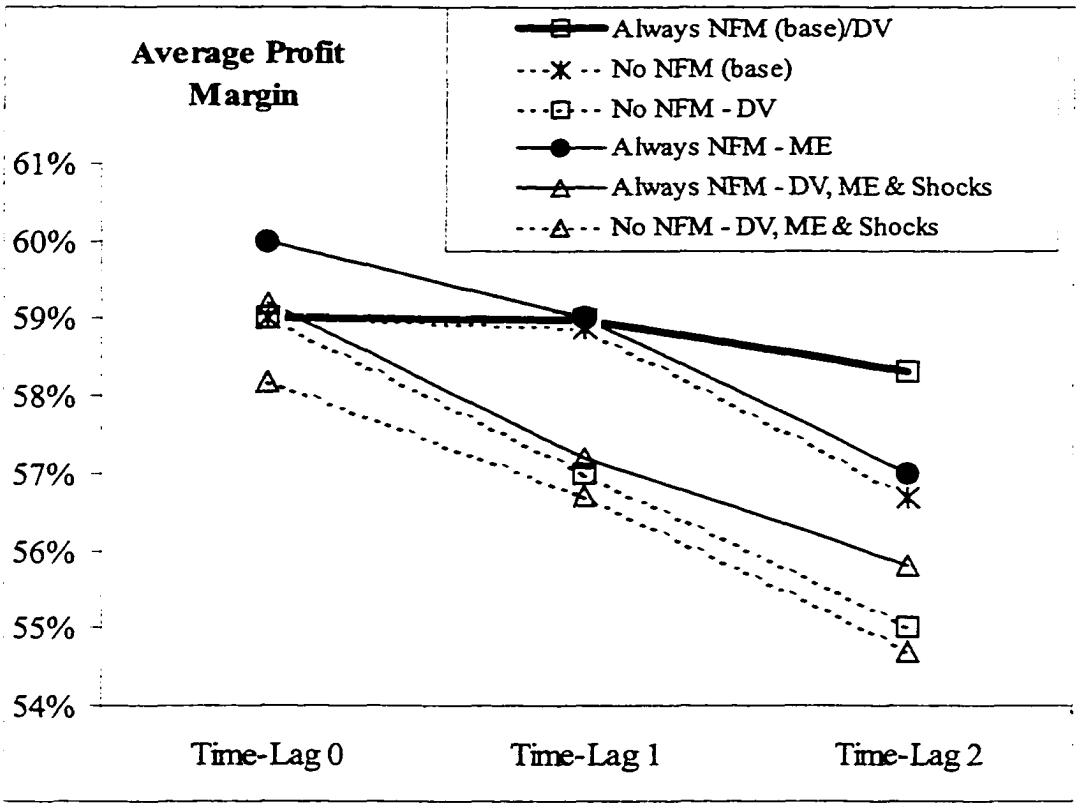
[89] Average Customer Growth is the average growth of customers during a period over the (100 period) simulation. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. DV, ME, and shocks refer to Demand Volatility, NFM Measurement Error, and random employee satisfaction and customer satisfaction shocks, respectively.

Figure D11: Average Customer Asset Value[90]



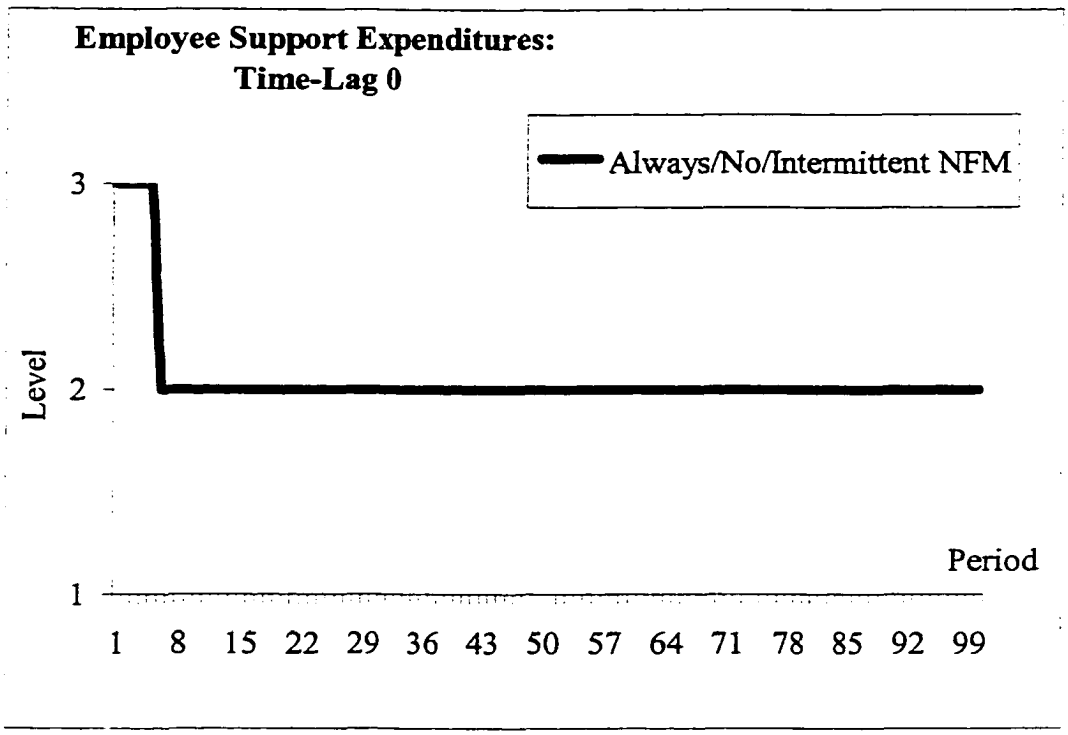
[90] Average Customer Asset Value is the average value of customers to the firm during a period over the (100 period) simulation. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. DV, ME, and shocks refer to Demand Volatility, NFM Measurement Error, and random employee satisfaction and customer satisfaction shocks, respectively.

Figure D12: Average Profit Margin[91]



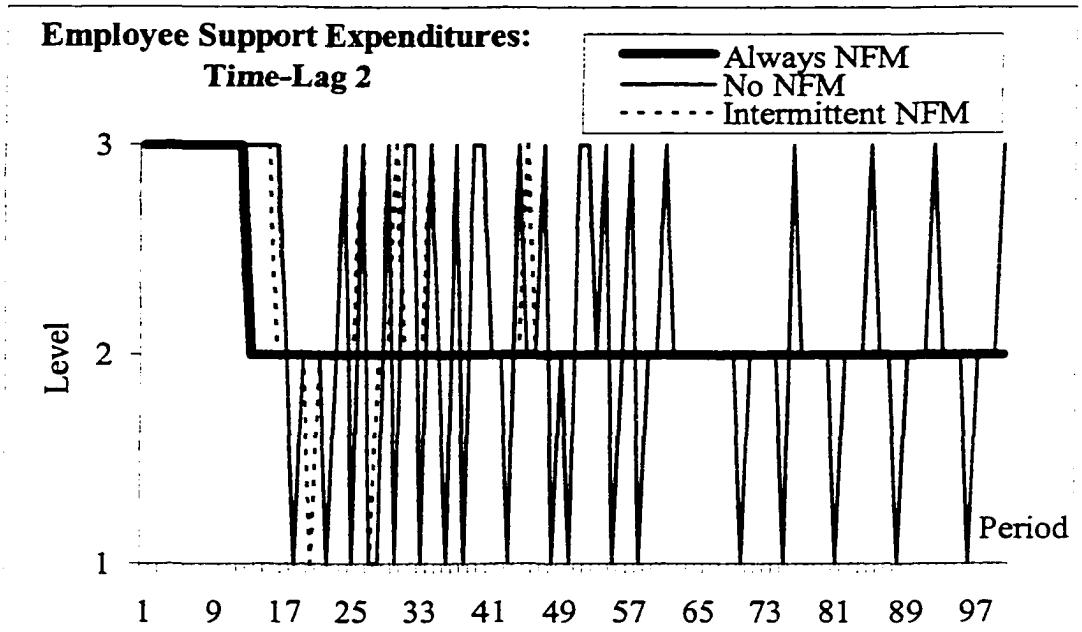
[91] Average Profit Margin is the average profit margin during a period over the (100 period) simulation. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. DV, ME, and shocks refer to Demand Volatility, NFM Measurement Error, and random employee satisfaction and customer satisfaction shocks, respectively.

Figure D13: Employee Support Expenditures: Time-Lag 0[92]



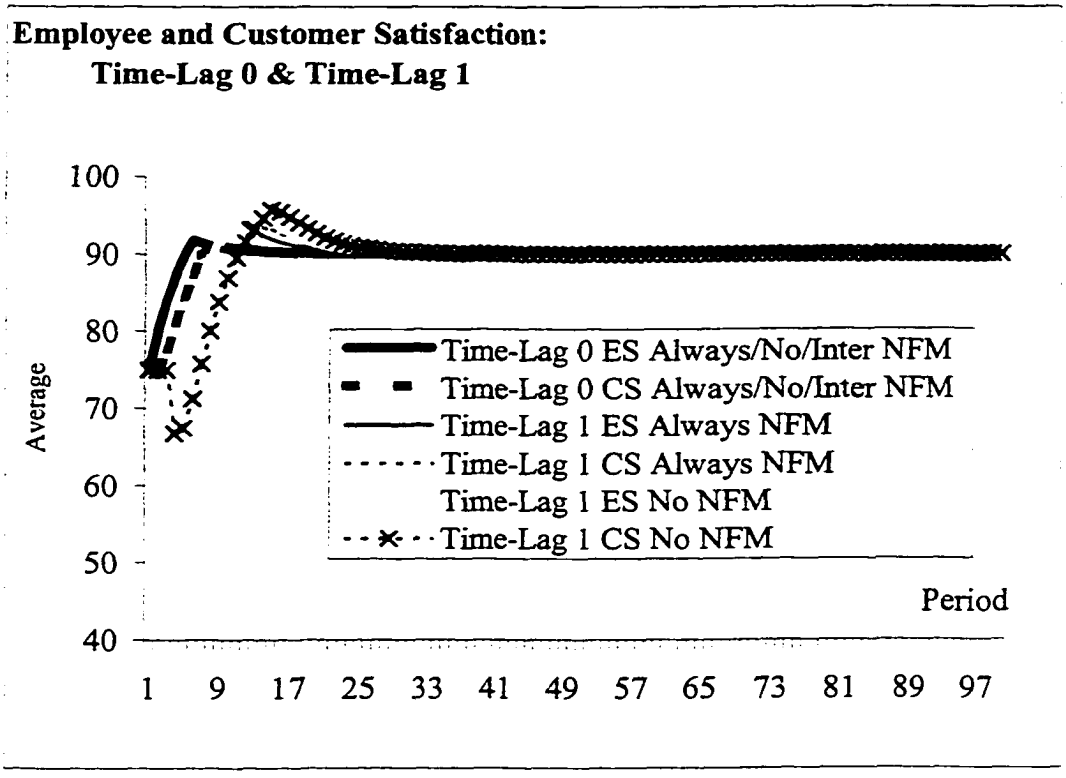
[92] The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures, while the Intermittent NFM decision framework supplements the financial measures with non-financial measures every fourth period. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. Period identifies the simulation period.

Figure D14: Employee Support Expenditures: Time-Lag 2[93]



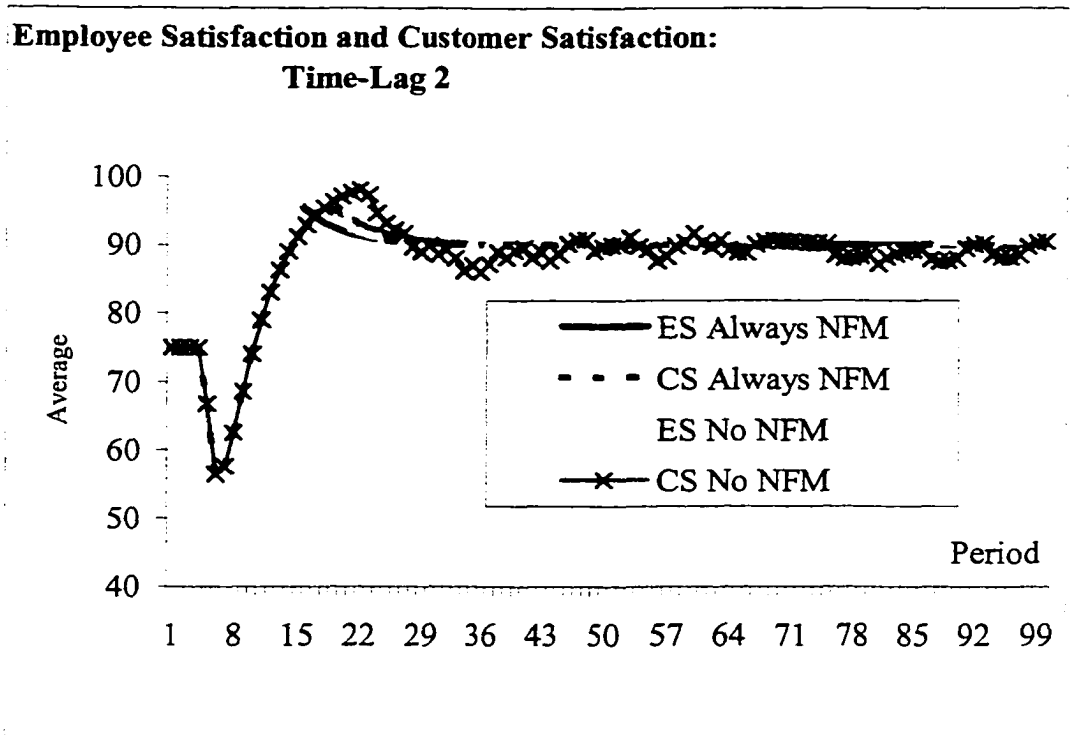
[93] The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures, while the Intermittent NFM decision framework supplements the financial measures with non-financial measures every fourth period. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. Period identifies the simulation period.

Figure D15: Employee and Customer Satisfaction: Time-Lag 0 and Time-Lag 1[94]



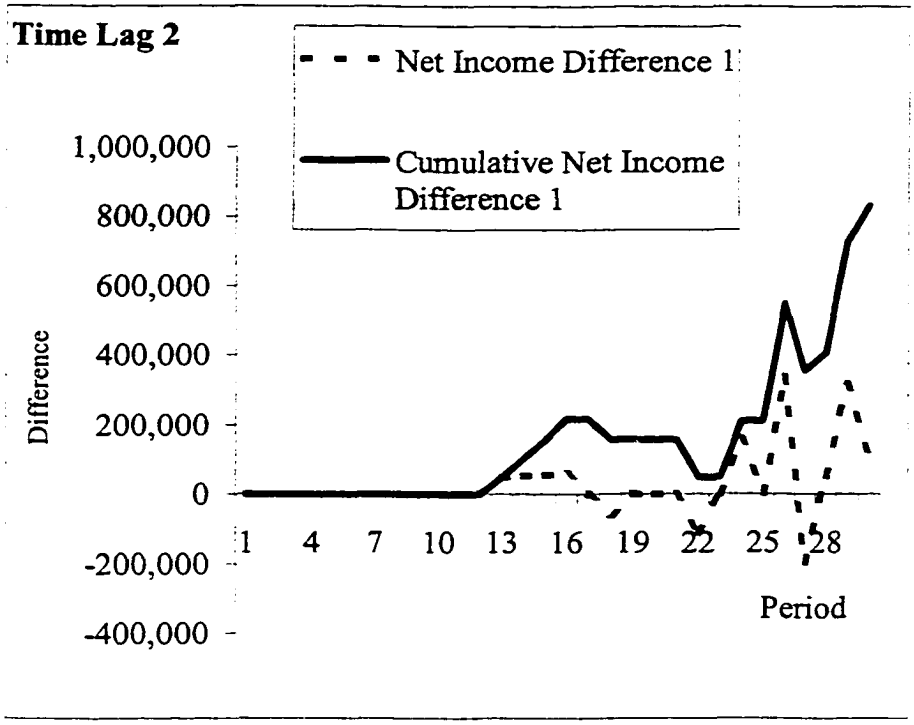
[94] The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures, while the Intermittent (Inter) NFM decision framework supplements the financial measures with non-financial measures every fourth period. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. Period identifies the simulation period. ES and CS stand for employee satisfaction and customer satisfaction, respectively.

Figure D16: Employee and Customer Satisfaction: Time-Lag 2[95]



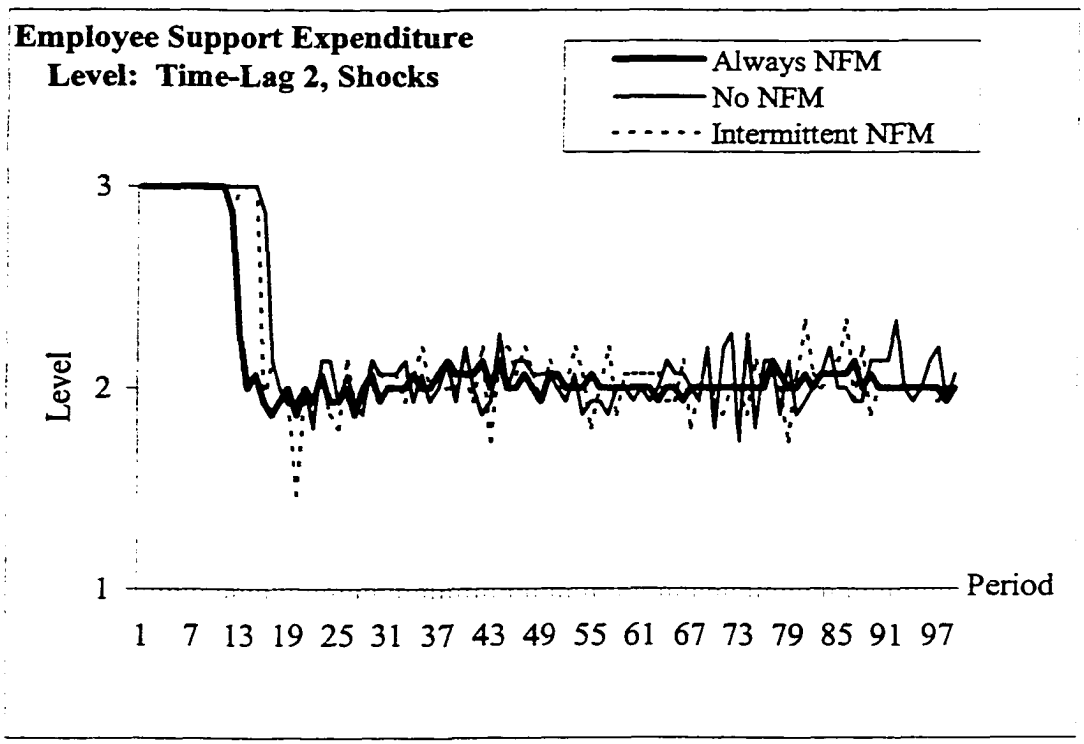
[95] The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. Period identifies the simulation period. ES and CS stand for employee satisfaction and customer satisfaction, respectively.

Figure D17: Cumulative Net Income Difference$_1$: Time-Lag 2[96]



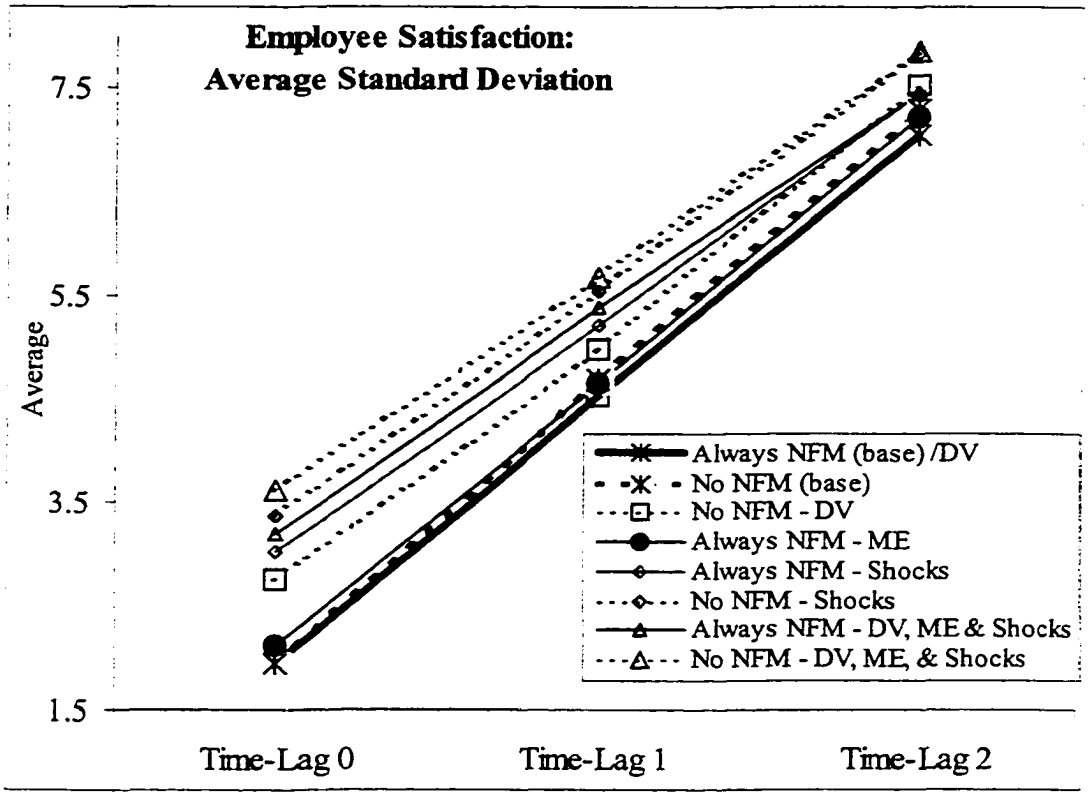
[96] Cumulative Net Income Difference$_1$ is the total difference in net incomes between the Always NFM and No NFM decision frameworks over the simulation horizon. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, while the No NFM decision framework only uses financial measures (net income). Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. Period identifies the simulation period.

Figure D18: Employee Support Expenditures: Time-Lag 2, Shocks[97]



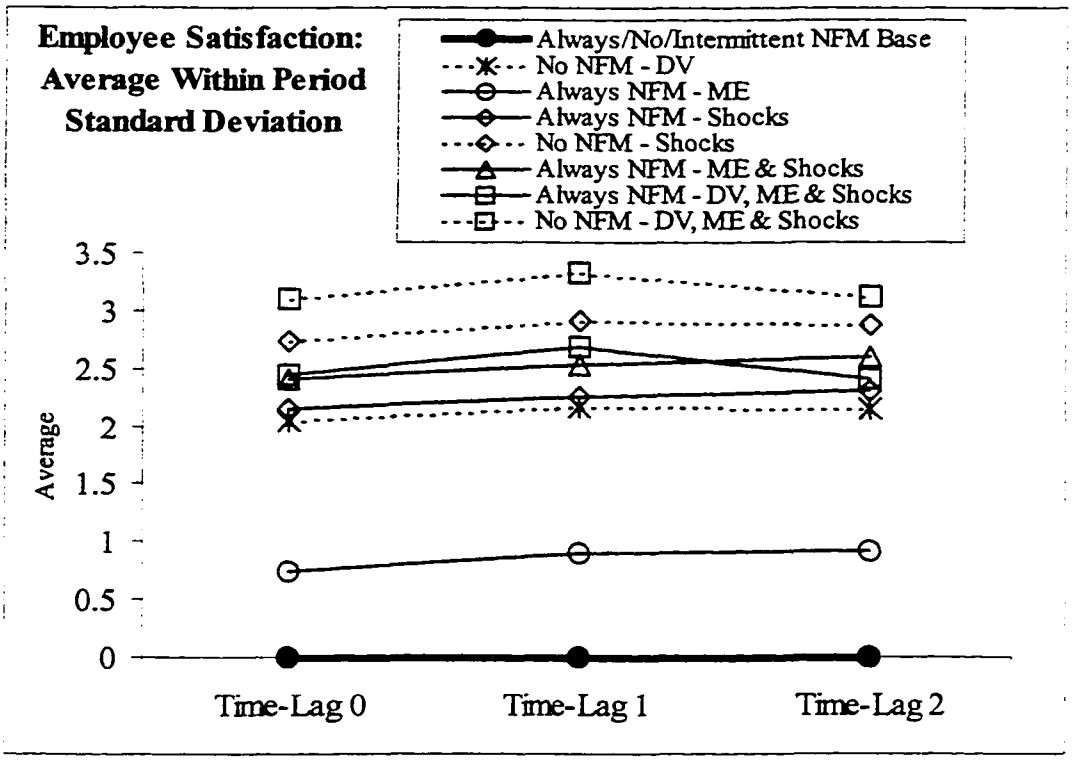
[97] The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures, while the Intermittent NFM decision framework supplements the financial measures with non-financial measures every fourth period. Period identifies the simulation period. Shocks refers to employee satisfaction and customer satisfaction shocks.

Figure D19: Employee Satisfaction: Average Standard Deviation[98]



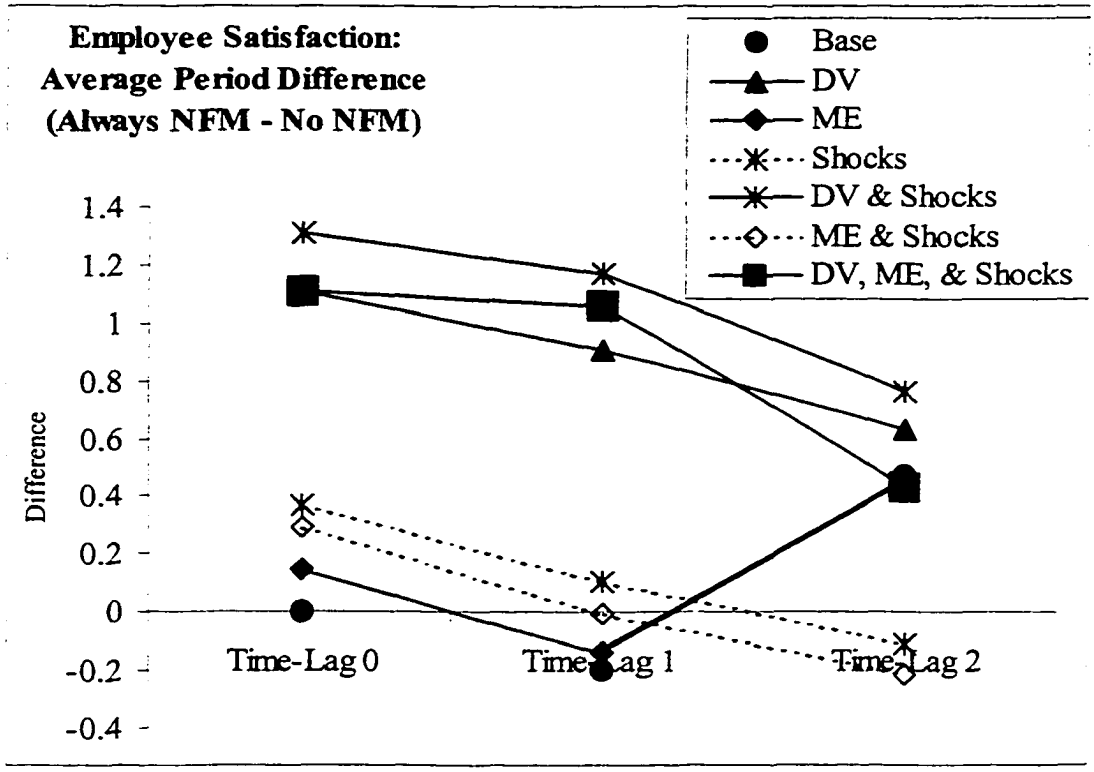
[98] Average Standard Deviation is the average standard deviation over the 100 period simulation. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. DV, ME, and shocks refer to Demand Volatility, NFM Measurement Error, and random employee satisfaction and customer satisfaction shocks, respectively.

Figure D20: Employee Satisfaction: Average Within Period Standard Deviation[99]



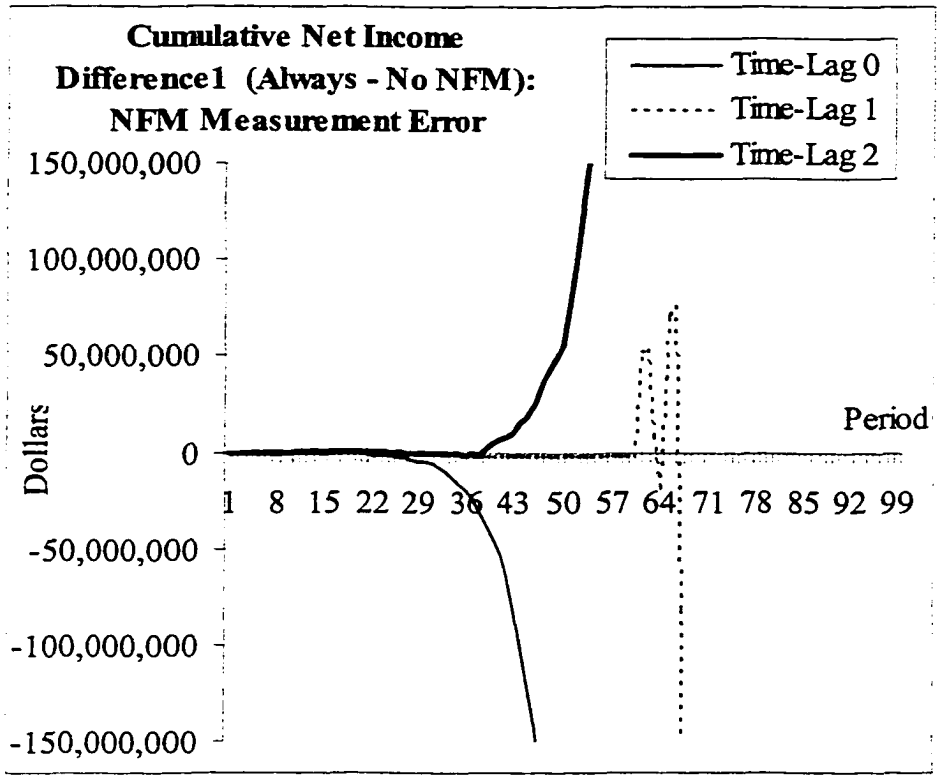
[99] Average Within Period Standard Deviation is the average standard deviation during a simulation period. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. DV, ME, and shocks refer to Demand Volatility, NFM Measurement Error, and random employee satisfaction and customer satisfaction shocks, respectively.

Figure D21: Employee Satisfaction: Average Period Difference[100]



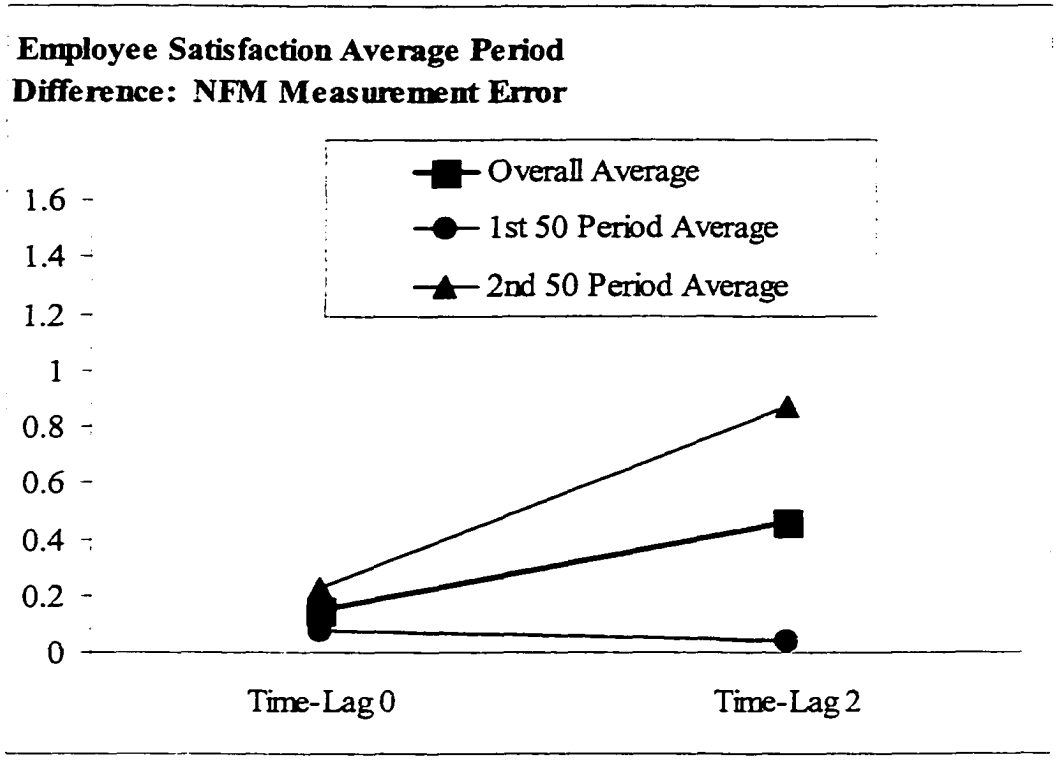
[100] The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. DV, ME, and shocks refer to Demand Volatility, NFM Measurement Error, and random employee satisfaction and customer satisfaction shocks, respectively.

Figure D22: Cumulative Net Income Difference$_1$: NFM Measurement Error[101]



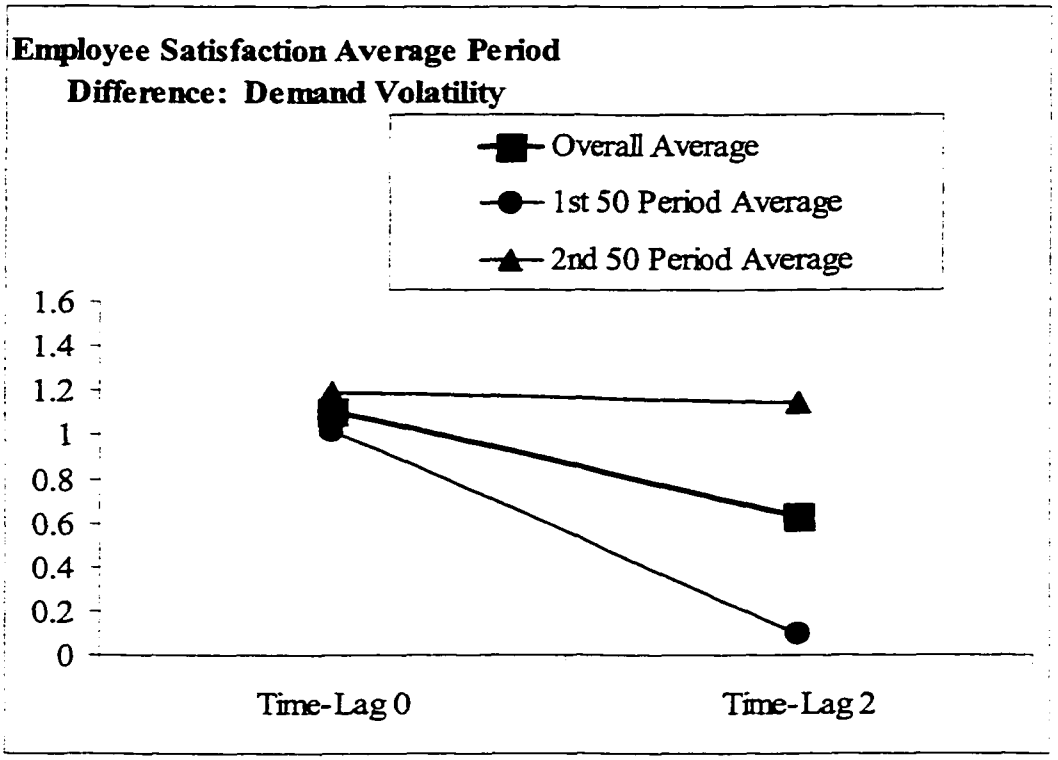
[101] Cumulative Net Income Difference$_1$ is the total difference in net incomes between the Always NFM and No NFM decision frameworks over the simulation horizon. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, while the No NFM decision framework only uses financial measures (net income). Period identifies the simulation period. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain.

Figure D23: Employee Satisfaction Average Period Difference: NFM Measurement Error, First and Second 50 Period [102]



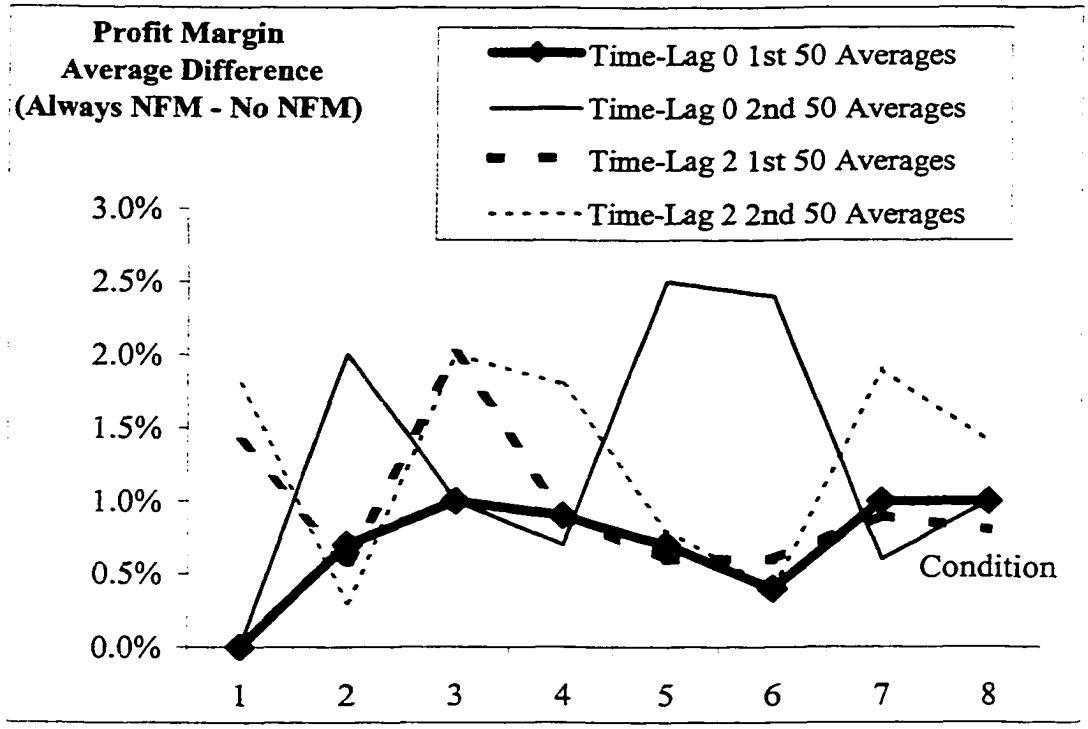
[102] The employee satisfaction difference equals the difference between the Always NFM employee satisfaction and No NFM employee satisfaction during a period. The 1st 50 period average is the average over periods 1 – 50, while the 2nd 50 period average is the average over periods 51 – 100. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain.

Figure D24: Employee Satisfaction Average Period Difference: Demand Volatility, First and Second 50 Periods [103]



[103] The employee satisfaction difference equals the difference between the Always NFM employee satisfaction and No NFM employee satisfaction during a period. The 1st 50 period average is the average over periods 1 – 50, while the 2nd 50 period average is the average over periods 51 – 100. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain.

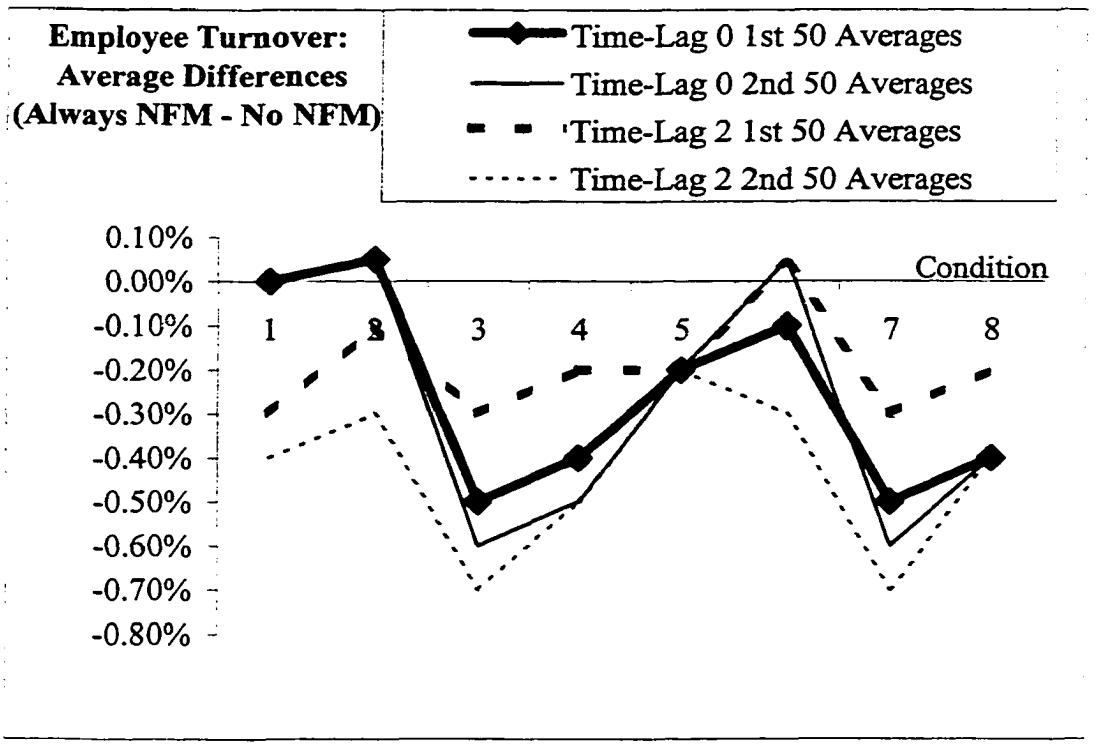
Figure D25: Profit Margin: Average Difference[104]



[104] The profit margin difference equals the difference between the Always NFM profit margin and No NFM profit margin during a period. The 1st 50 period average is the average in periods 1 – 50, while the 2nd 50 period average is the average in periods 51 – 100. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, while the No NFM decision framework uses only financial measures. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. Condition identifies the studied conditions and is defined as follows:

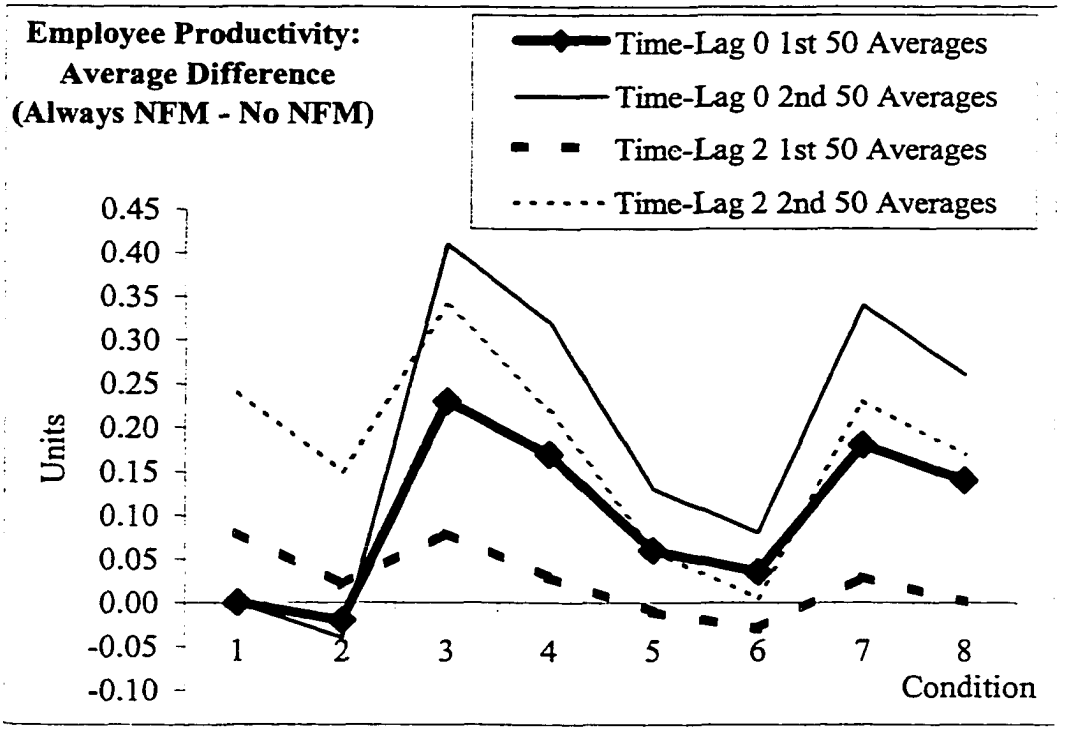
1: Base, Non-stochastic Case
2: NFM Measurement Error
3: High Demand Volatility
4: NFM Measurement Error, High Demand Volatility
5: (Employee Satisfaction and Customer Satisfaction) Shocks
6: Shocks, NFM Measurement Error
7: Shocks, High Demand Volatility
8: Shocks, NFM Measurement Error, High Demand Volatility

Figure D26: Employee Turnover: Average Difference[105]



[105] The employee turnover difference equals the difference between the Always NFM employee turnover and No NFM employee turnover during a period. The 1st 50 period average is the average in periods 1 – 50, while the 2nd 50 period average is the average in periods 51 – 100. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, while the No NFM decision framework uses only financial measures. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. Condition identifies the studied conditions and is defined as follows:
1: Base, Non-stochastic Case
2: NFM Measurement Error
3: High Demand Volatility
4: NFM Measurement Error, High Demand Volatility
5: (Employee Satisfaction and Customer Satisfaction) Shocks
6: Shocks, NFM Measurement Error
7: Shocks, High Demand Volatility
8: Shocks, NFM Measurement Error, High Demand Volatility

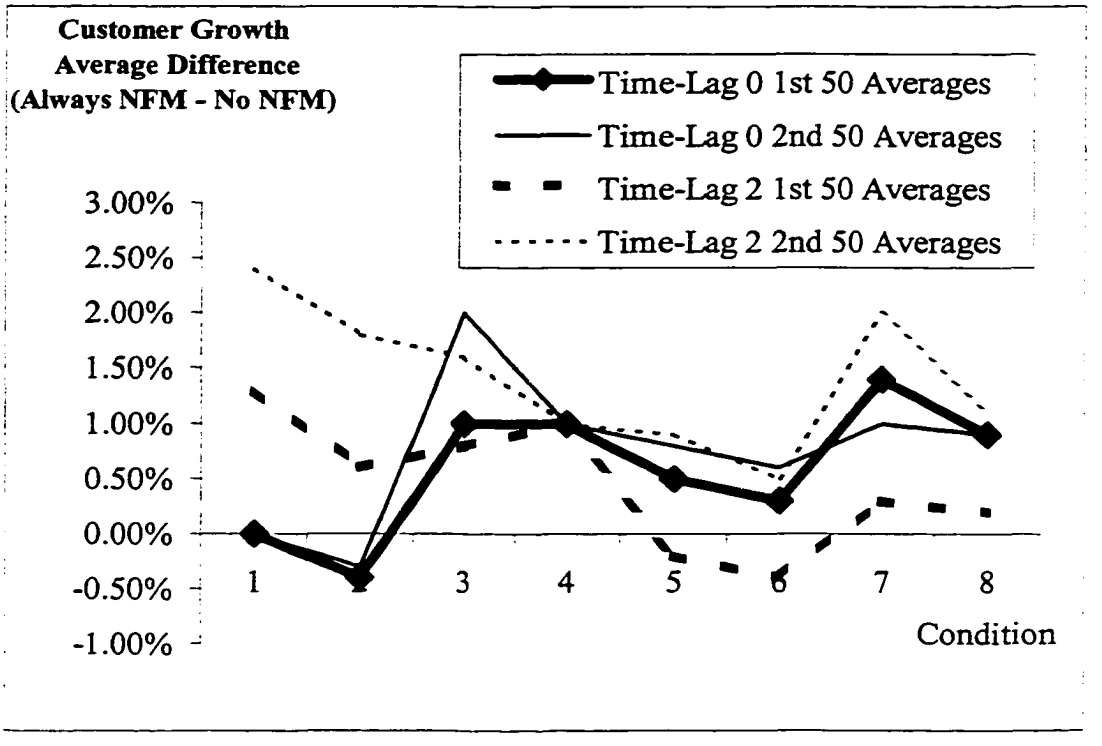
Figure D27: Employee Productivity: Average Difference[106]



[106] The employee productivity difference equals the difference between the Always NFM employee productivity and No NFM employee productivity during a period. The 1st 50 period average is the average in periods 1 – 50, while the 2nd 50 period average is the average in periods 51 – 100. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, while the No NFM decision framework uses only financial measures. Time-Lag indicates the time delay between the components of the Employee-Customer-Profit chain. Condition identifies the studied conditions and is defined as follows:

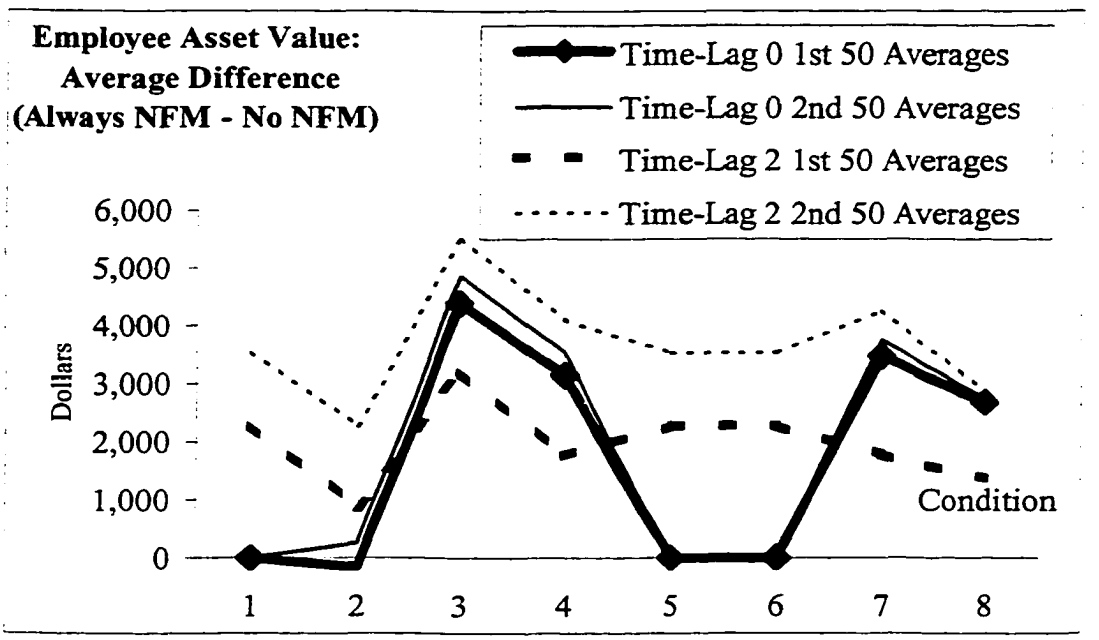
1: Base, Non-stochastic Case
2: NFM Measurement Error
3: High Demand Volatility
4: NFM Measurement Error, High Demand Volatility
5: (Employee Satisfaction and Customer Satisfaction) Shocks
6: Shocks, NFM Measurement Error
7: Shocks, High Demand Volatility
8: Shocks, NFM Measurement Error, High Demand Volatility

Figure D28: Customer Growth: Average Difference[107]



[107] The customer growth difference equals the difference between the Always NFM customer growth and No NFM customer growth during a period. The 1st 50 period average is the average in periods 1 – 50, while the 2nd 50 period average is the average in periods 51 – 100. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. Condition identifies the studied conditions and is defined as follows:
1: Base, Non-stochastic Case
2: NFM Measurement Error
3: High Demand Volatility
4: NFM Measurement Error, High Demand Volatility
5: (Employee Satisfaction and Customer Satisfaction) Shocks
6: Shocks, NFM Measurement Error
7: Shocks, High Demand Volatility
8: Shocks, NFM Measurement Error, High Demand Volatility

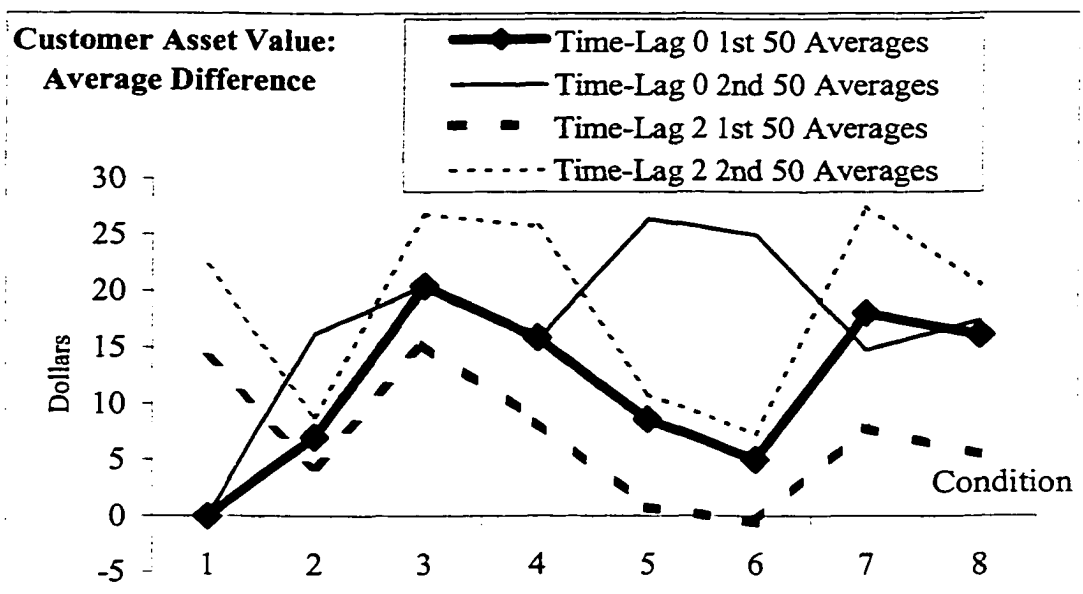
Figure D29: Employee Asset Value: Average Difference[108]



[108] The employee asset difference equals the difference between the Always NFM employee asset value and No NFM employee asset value during a period. The 1st 50 period average is the average over periods 1 – 50, while the 2nd 50 period average is the average over periods 51 – 100. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. Condition identifies the studied conditions and is defined as follows:

1: Base, Non-stochastic Case
2: NFM Measurement Error
3: High Demand Volatility
4: NFM Measurement Error, High Demand Volatility
5: (Employee Satisfaction and Customer Satisfaction) Shocks
6: Shocks, NFM Measurement Error
7: Shocks, High Demand Volatility
8: Shocks, NFM Measurement Error, High Demand Volatility

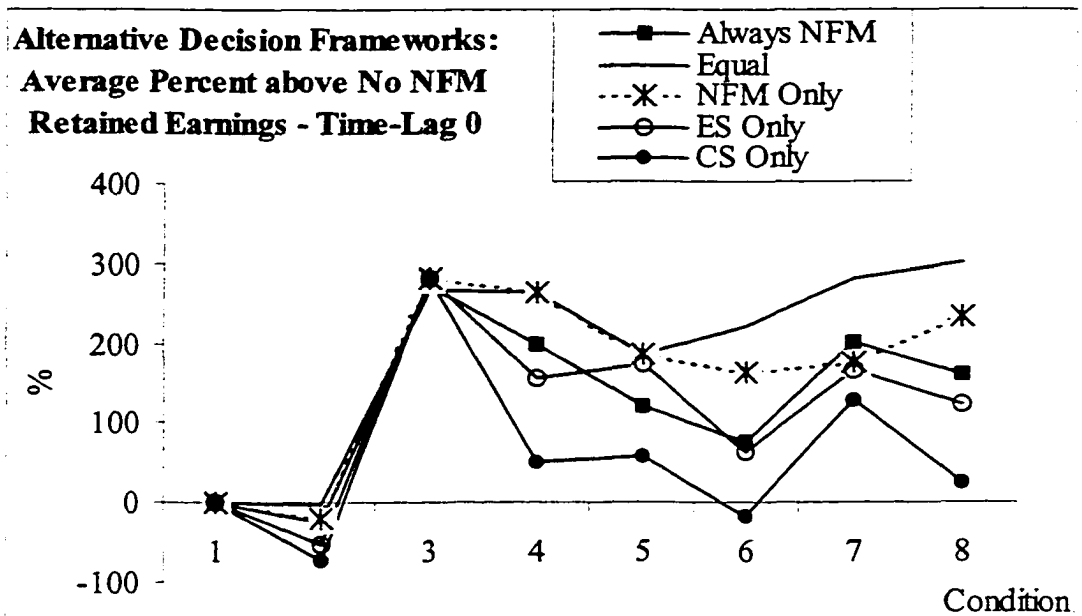
Figure D30: Customer Asset Value: Average Difference[109]



[109] The customer asset difference equals the difference between the Always NFM customer asset value and No NFM customer asset value during a period. The 1st 50 period average is the average in periods 1 – 50, while the 2nd 50 period average is the average in periods 51 – 100. The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. Condition identifies the studied conditions and is defined as follows:

1: Base, Non-stochastic Case
2: NFM Measurement Error
3: High Demand Volatility
4: NFM Measurement Error, High Demand Volatility
5: (Employee Satisfaction and Customer Satisfaction) Shocks
6: Shocks, NFM Measurement Error
7: Shocks, High Demand Volatility
8: Shocks, NFM Measurement Error, High Demand Volatility

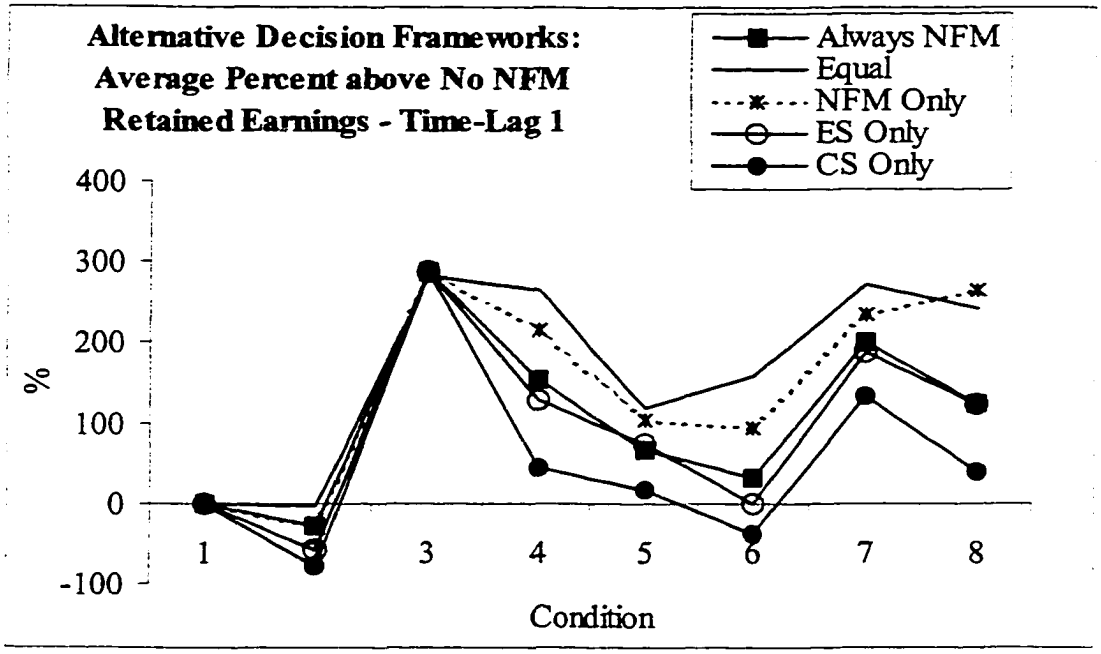
Figure D31: Alternative Decision Frameworks: Average Percent above No NFM Retained Earnings, Time-Lag 0[110]



[110] The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. ES and CS refer to employee satisfaction and customer satisfaction, respectively. Condition identifies the studied conditions and is defined as follows:

1: Base, Non-stochastic Case
2: NFM Measurement Error
3: High Demand Volatility
4: NFM Measurement Error, High Demand Volatility
5: (Employee Satisfaction and Customer Satisfaction) Shocks
6: Shocks, NFM Measurement Error
7: Shocks, High Demand Volatility
8: Shocks, NFM Measurement Error, High Demand Volatility

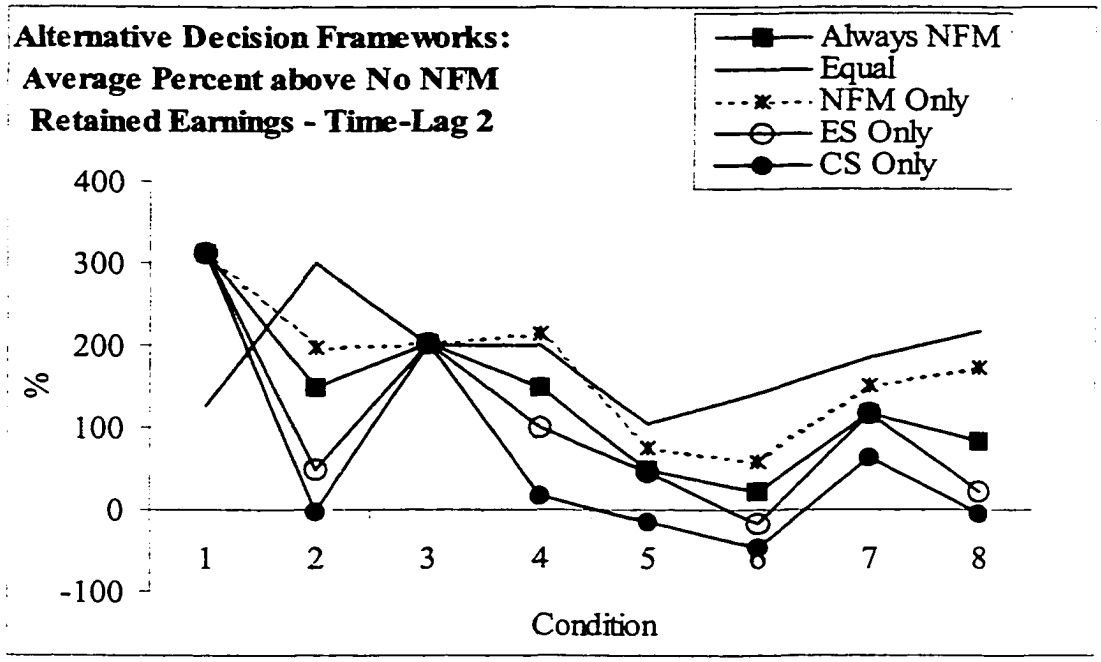
Figure D32: Alternative Decision Frameworks: Average Percent above No NFM Retained Earnings, Time-Lag 1[111]



[111] The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. ES and CS refer to employee satisfaction and customer satisfaction, respectively. Condition identifies the studied conditions and is defined as follows:

1: Base, Non-stochastic Case
2: NFM Measurement Error
3: High Demand Volatility
4: NFM Measurement Error, High Demand Volatility
5: (Employee Satisfaction and Customer Satisfaction) Shocks
6: Shocks, NFM Measurement Error
7: Shocks, High Demand Volatility
8: Shocks, NFM Measurement Error, High Demand Volatility

Figure D33: Alternative Decision Frameworks: Average Percent above No NFM Retained Earnings, Time-Lag 2[112]



[112] The Always NFM decision framework uses non-financial measures and financial measures to make Employee Support Expenditure decisions, which are designed to increase employee satisfaction. The No NFM decision framework uses only financial measures. ES and CS refer to employee satisfaction and customer satisfaction, respectively. Condition identifies the studied conditions and is defined as follows:

1: Base, Non-stochastic Case
2: NFM Measurement Error
3: High Demand Volatility
4: NFM Measurement Error, High Demand Volatility
5: (Employee Satisfaction and Customer Satisfaction) Shocks
6: Shocks, NFM Measurement Error
7: Shocks, High Demand Volatility
8: Shocks, NFM Measurement Error, High Demand Volatility

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Vita

Marcia Lynne Weidenmier, the daughter of Mary Louise Weidenmier and Carl Henry Weidenmier, was born in Gainesville, Florida on June 21, 1967. After completing her work at Episcopal High School, Jacksonville, Florida, in 1985, she entered the College of William and Mary in Williamsburg, Virginia. She received the degree of Bachelor of Business Administration in May 1989. She then entered The University of Texas at Austin where she received the degree of Master of Business Administration in August 1991. During the following four years, she was employed as an information systems consultant for Price Waterhouse in Chicago, Illinois. In August 1995, she entered the Graduate School of The University of Texas.

Permanent Address: 3201 Duval Road #226, Austin, Texas 78759

This dissertation was typed by the author.