The Impact of Radio Frequency Identification

on the Sarbanes-Oxley Act of 2002

by

David R. Schannon

Submitted to the Department of Electrical Engineering and Computer Science
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ABSTRACT

In the early years of the 21st century, a number of corporate accounting scandals forced the government to hastily adopt regulations aimed at protecting investors and restoring confidence in the financial markets. Among its provisions, the Sarbanes-Oxley Act of 2002 requires public companies on a best effort basis to set up internal controls and procedures ensuring the proper collection and recording of data in their financial statements. The ambiguity and qualitative nature of the law exposes companies to the necessity of providing fine-grained item level financial information. Such information is made possible by the application of advanced technologies such as Radio Frequency Identification (RFID). As companies begin to use RFID systems to comply with the Sarbanes-Oxley Act, the Act's deficiencies and insatiable requirement for detailed information will provide fertile ground for lawsuits against those companies that do not fully implement item level RFID technologies. Policymakers will need to revise and clarify the Sarbanes-Oxley Act in order to avoid these costly lawsuits and to protect the values on which the Act was written.

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Chapter 1 – Introduction

Technological advancements have always carried with them social and legal consequences. When televisions were introduced, thousands of theaters were closed as people preferred to watch shows in the comfort of their own home. As the internet became ubiquitous, e-commerce threatened to send traditional brick-and-mortar businesses to bankruptcy [1]. The ability to clone genes brought about a nationwide discussion of ethics in science. For every new invention, societal norms must be reevaluated. Often, if the invention has potentially serious side effects, the government must step in and regulate its use. In more specific cases, some inventions cause existing laws to become obsolete, requiring updates to the regulations. For example, the invention of MP3's and digital music has forced the government to reevaluate its copyright laws and to issue new regulations specifying how the new invention fits in with the intentions of the old laws. Until the laws were updated, however, numerous cases of alleged theft and copyright infringement were brought to the courts. Billions of dollars were spent undoing the damage caused by laws that were not equipped to handle the consequences of the new invention. Identifying these issues before they arise is a difficult process and often an exercise in predicting the future. However, successful foresight can save companies and the government billions of dollars in legal fees and bad publicity and can speed the adoption of technologies that benefit society.

In this thesis, I discuss Radio Frequency Identification (RFID) technologies and their use as tools for compliance with the Sarbanes-Oxley Act of 2002. Similar to digital music's effect on the existing copyright laws, RFID technologies will soon have serious

consequences on the interpretation of the Sarbanes-Oxley Act. However, unlike the digital music fiasco, this thesis serves to induce industries and the government to make preemptive changes to the law, saving both corporations and government agencies billions of dollars.

1.1 The History of the Sarbanes-Oxley Act of 2002

At the end of 2001, Enron, the world's largest energy company, filed for bankruptcy as a result of the biggest corporate scandal in history. An in depth investigation revealed the company's history of fraudulent accounting and reporting of earnings. Soon after, Global Crossing, Tyco International, WorldCom, and other corporate giants were discovered to have committed similar crimes, each manipulating their accounting books to appear more profitable. As confidence in America's financial system hit record lows, the Bush administration felt that something must be done. What emerged from Congress in July, 2002 was the Sarbanes-Oxley Act of 2002 ("the Act"), a law meant "To protect investors by improving the accuracy and reliability of corporate disclosures made pursuant to the securities laws" [2]. Applying only to publicly traded companies, the Act focuses on improving the information that public companies provide to their investors. First, the Act aims to promote uniform accounting practices by setting specific accounting standards that can be evaluated. Second, the Act seeks to make all of a company's transactions more transparent to its shareholders. Finally, it intends to hold management individuals personally accountable for the company's financial reporting.

With these goals in mind, the Act seeks to put confidence back into the financial markets and America's corporations.

While the Act affects many aspects of a company's organization, its application to the supply chain has a particularly strong impact on the company's financial accounting. Section 401 of the Act requires the disclosure of all off-balance sheet transactions. These transactions are defined as any obligation under certain "guarantee" contracts, in which an interest in assets is transferred. In addition, the definition includes obligations under derivative instruments or an interest providing financing, liquidity, market risk, or credit risk [3]. Included in this definition are purchasing contracts. Thus, in the supply chain, the Act requires full disclosure of all transactions that result from purchasing contracts. This amounts to complete documentation and disclosure of all shipments and deliveries of purchased goods. To comply with these requirements, companies must report some very specific information. The required disclosures include a statement of the nature and business purpose of the off-balance sheet transactions, the financial impact of the arrangements, and an explanation of any changes from the previous year. Contractual obligations must be placed in a table specifying how much money is committed over the course of the year. Finally, to fully comply with the Act, these disclosures must be made in a timely manner, reflecting accurate data for the time period covered in the report.

In addition to disclosing all transactions, companies must set controls and procedures for ensuring effectiveness of their accounting systems. Section 404 of the Act requires management to maintain an internal control system designed to ensure accurate, complete, and timely processing, recording, and summarizing of the information required to be disclosed in the reports. In addition, officers must assess and evaluate the

effectiveness of this control system. For each industry, the structure of these procedures may be quite different. The Act instructs companies to tailor their control procedures to match with their business structure and needs. For example, an e-business software provider has vastly different accounts and transactions from those of a faucet manufacturer. The companies' control procedures should be tailored to their operations and industry. Documentation of the controls should include an explanation of how the information is collected and communicated to those responsible for the report, and how the process relates to the financial reporting system. The SEC takes Section 404 very seriously. Failure to maintain controls and procedures can lead to punitive action, even if none of the disclosures are flawed. In addition, the Act mandates that by verifying the presence and effectiveness of these controls, company officers are held personally responsible for any fraudulent reporting [3].

Complying with Sarbanes-Oxley has proven to be a costly endeavor. In the first year of compliance with the Act, an estimated 1% of a company's revenue is devoted to developing the internal controls required by the Act [4]. Many companies have hired full-time employees to take on the task of compliance, and millions of dollars have been spent on software solutions aimed to help ease the transition into compliance. As these costly measures have significant impact on a company's finances, workload, and day-to-day operations, the search continues for cheap, efficient, reliable, and timely solutions to the problem of Sarbanes-Oxley compliance. Radio Frequency Identification (RFID) systems and technologies can be significant components of the solution.

1.2 Radio Frequency Identification

If properly implemented, an RFID system can track not only the physical flow of goods coming into and out of the company, but also the financial flows associated with those goods. As a result, the RFID system can act as an automated Sarbanes-Oxley compliant control system intended to ensure the proper accounting of transactions up and down the supply chain. RFID has numerous benefits over other manual entry and barcode based compliance systems. First, RFID enables perfect item-level information. While typical inventory management systems only go as far as pallet-level information, RFID has the ability to track each item on a pallet. Thus, partially filled pallets can be properly accounted for. This high level of granularity affords incredible detail in the disclosures. Not only can RFID be specific, it is also accurate and reliable. An RFID system can be developed and implemented so that all items are identified with near 100% accuracy in all locations of interest.

Second, the benefits of an RFID system vastly outweigh the costs [5] [6]. Once the fixed costs of the system are in place, the only continuing costs are system maintenance and the individual tags. As the technology improves, both fixed infrastructure and continuing costs are becoming low enough to be economically feasible for a plethora of applications requiring automated item identification.

A third benefit of RFID is its efficiency. Unlike barcodes, numerous RFID tags can be read simultaneously without human intervention, enabling truckloads of goods to be inventoried in a fraction of a second. This time- and labor-saving approach will reduce the costs associated with data collection and entry required for Sarbanes-Oxley compliant control systems. Fourth, RFID systems are easy to use. Simply passing a tag

near a reader will record the tag's information into the system. Thus, inventorying an entire truckload of goods is as simple as driving the truck under a reader. Finally, with an RFID system in place, companies can benefit from the system's capabilities beyond simply becoming Sarbanes-Oxley compliant. They may take advantage of the accurate asset tracking and tracing information to improve supply chain performance and reduce overall operating costs. Additional applications are also possible with an RFID system. For example, RFID systems can track temperature history, which can help retailers determine the remaining lifetime of delivered produce. These benefits make an RFID system an attractive option to aid in becoming Sarbanes-Oxley compliant.

1.3 The Impact of RFID on Sarbanes-Oxley

Because of its obvious applications toward Sarbanes-Oxley compliance and improved supply chain efficiencies, RFID will soon become a standard technology used for item identification within the supply chain. As more and more companies integrate RFID systems into their operations, the fundamental technologies and operational capabilities on which the Sarbanes-Oxley Act was written will have changed. The Act's qualitative nature requires companies to put forth a "best effort" attempt at ensuring the proper collection of data and preparation of its financial statements. The law gives no specific details as to what "best effort" means in different industries. As time passes, the SEC is expected to slowly narrow down which controls are acceptable and which are not. However, the introduction of RFID systems will allow companies to collect perfect information and prepare precise financial statements directly from the data. This

certainly raises the best effort bar, changing the playing field and putting a new perspective on what used to be considered acceptable for compliance.

This change in detectable information is similar to the technological changes that have occurred in the detection of pollutants since the Clean Air Act was established. Pollutant levels that were undetectable when the Clean Air Act was written are now detectable. The "best effort" nature of the law requires that companies must now upgrade their pollution prevention systems to eliminate what were previously undetectable levels of pollution [7].

When RFID technology becomes commonplace, the question will no longer become whether companies are intentionally trying to mislead their investors. The main issue will be whether they are putting forth the best possible effort to give their shareholders the most precise data possible. Is RFID the only solution for precise preparation of financial statements? Will other solutions be acceptable, knowing RFID's potential? Where will the line be drawn between what exemplifies best effort and what attempts are below standards? These questions will all soon need to be answered. If the law and its intentions are not soon clarified, these issues will be brought up in the federal courts, costing companies and the government billions of dollars. This thesis is a preemptive attempt to convince corporations, the SEC, and other government agencies responsible for the Sarbanes-Oxley Act to clarify its wording and intentions, as advancements in item tracking technology may threaten to make the current version of the Act obsolete.

1.4 Thesis Overview and Contributions

In the remainder of this thesis, I show that the item-level granularity available with Radio Frequency Identification technologies will change the technical assumptions on which the Sarbanes-Oxley Act was written. As a result, in order to avoid costly lawsuits, policymakers must revise and clarify the terms of the Act.

I begin in Chapter 2 by laying the foundations on which the Sarbanes-Oxley Act was written. I discuss the history of the Enron scandal and its impact on the financial markets. Knowing the history of the Act allows us to understand the Act's intended purposes which I will fall back upon in evaluating the Act's effectiveness.

In Chapter 3, I discuss the Act and the requirements for compliance. In this chapter, I focus on the Act's four main areas of reform, namely corporate governance, disclosures and financial reporting, audit process and oversight, and regulation and enforcement. Before getting into the supply chain-relevant sections of the Act, it is important to have a broad understanding of the scope of the entire Act.

In Chapter 4, I outline the operations of the supply chain. Specifically, I focus on the seven major processes of the supply chain: plan, source, produce, store, sell, transport, and return. Here, I detail the relevant processes that are important in the analysis of Sarbanes-Oxley in the supply chain.

In Chapter 5, I explain how the Sarbanes-Oxley Act is relevant to each of the supply chain processes. Specifically, Sections 401 and 404 of the Act are laid out in detail, with examples of what is necessary for compliance. I end this chapter with a discussion of the ideal characteristics that a system must possess in order to fully comply with the supply chain-related sections of the Act.

In Chapter 6, I introduce RFID and explain how its capabilities can fulfill the requirements needed for Sarbanes-Oxley compliance. For each of the characteristics specified in the previous chapter, I explain how they can be implemented by an RFID system.

In Chapter 7, I assess the current uses of RFID in the supply chain and discuss the inevitable ubiquity of the technology in the future. I look specifically at the recent edicts of the Department of Defense, Wal-Mart, and others, and give an overall sense of where the technology is headed. In this chapter, I also explain why there might be delays in the widespread use of RFID in the supply chain.

In Chapter 8, I discuss how, since RFID is such a perfect fit for Sarbanes-Oxley compliance, it is inevitable that it will be used as such at some point in the future. I argue that the item-level granularity that RFID provides alters the fundamentals on which Sarbanes-Oxley was written. As a result, I suggest that corporations and the government must seriously consider clarifying or altering the Act before lawsuits are necessary to resolve its ambiguities

Finally, I conclude in Chapter 9 with a list of the contributions I have made to the corporate and legal world. Most significantly, as RFID becomes ubiquitous in the supply chain, its use as a compliance tool for Sarbanes-Oxley is inevitable. However, the availability of this new technology raises the "best effort" bar set by the law's original wording. To resolve this, the government must look back to the intentions for which the Sarbanes-Oxley Act was written and clarify the Act's provisions, taking into account the new technology.

Chapter 2 – The Enron Scandal

The Sarbanes-Oxley Act was drafted as Congress's response to a number of corporate accounting frauds that were revealed in the early years of the 21st century. While a number of companies were found guilty of misleading investors with the use of creative accounting techniques, the largest and most public of the scandals was that of Enron Corporation.

2.1 Enron's History

Enron was founded in 1985 as the result of a merger between Houston Natural Gas and InterNorth. Its name was created with the purpose of combining notions of energy and the environment ("En") with the suffix "on" from the gas and oil giants such as Exxon and Chevron [8]. Even from its beginnings, Enron was destined to become an energy powerhouse. Although Enron started out as a natural gas provider, the constant price wars and the struggle for deregulation in the late 1980's and early 1990's provided an opportunity for Enron to expand into a different market. CEO Ken Lay and future COO Jeffrey Skilling soon realized that highly lucrative opportunities existed by treating natural gas as a financial instrument. They created options to buy gas at a fixed price at a later date, and began to trade those options. By the mid 1990's, Enron had fully grown into the financial services sector, and was looking to expand into other energy-related ventures, such as electricity, paper and pulp, energy services, and water. Reflecting its

success, Enron's earnings rose an average of 20% per year, and soon, investors began expecting similar high growth from year to year. These expectations contributed to a highly competitive "must win" atmosphere within the company. In order to keep their jobs, employees had to consistently outdo themselves.

In the summer of 1996, however, traders bet wrong on gas prices, resulting in losses totaling more than $90 million. Because their earnings target for the quarter was set at $100 million, Enron executives had to think fast to make up their $190 million shortcomings. Enron had never before missed an earnings target, and it was certainly not ready to start. With some fast thinking, a group headed by Chief Accounting Officer Rick Causey was able to blatantly stretch the generally accepted accounting principles (GAAP) to make up the losses. Specifically, Enron revalued its equity investments as the *future* value of the investments. Companies they purchased for $30 million were being recorded on the books as worth $45 million. Mimi Swartz, author of *Power Failure: The Inside Story of the Collapse of Enron*, compares this to "asking a stockbroker to sell a $50 stock for $80 now because it might reach that in three years" [8]. Basically, the "fair value" technique, as Enron called it, was clearly stretching the standards of accounting. It was unlikely that Arthur Anderson, Enron's auditing firm, would approve the use of the technique. However, Arthur Anderson, which had at one time been one of the top accounting firms in the world, had recently slipped down to number five on the list. As Enron was one of its biggest and most successful clients, it could not afford to lose Enron. As a result, Anderson signed off on Enron's plan to use fair value accounting in their books, thus making up the $190 million deficit.

Enron took advantage of many other accounting subtleties in addition to the fair value technique. In order to mask the company's massive debt, Enron created numerous Special Purpose Entities (SPEs) to keep unwanted figures off of its balance sheets. An SPE is in essence a separate entity, to which a company transfers assets or financial activities. The SPE is legally distanced from the company, so its holdings are isolated from the company's financial statements. Enron used this vehicle to transfer out debt, making the company appear to be more profitable than it actually was. Another technique Enron used to buffer its earnings was to sell off assets for inflated prices before the end of the quarter, promising to buy them back after the quarterly reports were filed. In 1999, Enron used this technique to sell three barges off the coast of Nigeria. Merrill Lynch agreed to buy the barges, with the understanding that they would be bought back with a significant fee for Merrill Lynch's troubles. Enron booked that sale as profits, helping them reach their year end earnings target.

2.2 Enron's Fall

Enron had become very adept at stretching GAAP and doing whatever it took to hit its earnings targets. However, with each deal, more debt was accumulated and more people were becoming suspicious. Beginning in the spring of 2001, financial reporters began noticing the discrepancies on Enron's financial statements. While Lay and Skilling tried to discredit the claims, whistleblowers inside the company urged management to come clean. Enron's stock, which had dropped from a high of $90 to less than $10, reflected the public's growing skepticism over the company's accounting

practices. Finally, Enron officials decided to stop the bleeding and tell the truth. On October 16, 2001, Enron claimed a $638 million loss in its third quarter earnings report. With its credit rating sinking from BBB+ to BBB to BBB-, it was coming dangerously close to junk bond status. When that day came, on November 28, contract stipulations triggered $3.9 billion in debt, payable in 30 days. The stock price dropped to 27 cents. Enron could no longer sustain itself, and filed for bankruptcy on December 2, 2001. Over 4,000 workers were laid off [9].

In the ensuing months and years, numerous Enron executives were indicted for various accounts of fraud. Many, including CFO Andy Fastow, were heavily fined and given hefty jail sentences. Arthur Anderson was found guilty of obstruction of justice for destroying documents and was banned from auditing public companies. Executives from Merrill Lynch involved in the Nigerian barge deal, an Enron deal designed to hide losses, were also indicted.

2.3 Economic Repercussions

While Enron was the largest and most complicated case of fraudulent accounting, it certainly was not the only one. Tyco International, WorldCom, Adelphia, Global Crossing, and others all fell victim to similar "cooking of the books." Public awareness of corporate deception skyrocketed. This lack of faith in the economy caused investors to be much wearier with their investments. This phenomenon is described by Benson et al. in Following the Money:

"To the extent that the market deems accounting information unreliable, investors confront 'information risk' in making investment decisions. The higher the information risks, the less attractive are stocks in comparison with alternative investments. Higher information risk thus depresses stock prices" [10].

The stock market suffered from the loss of information credibility caused by the multiple financial scandals. Beginning at the end of 2001 through the middle of 2002, the Dow Jones Industrial Average (DJIA) dropped over 30% [11]. Figure 1 shows the DJIA over the past 5 years, noting the major events related to Enron and the economy. By one estimate by the Brookings Institution, the accounting scandal crisis reduced the United States GDP by $40 billion, or 0.4% [12].

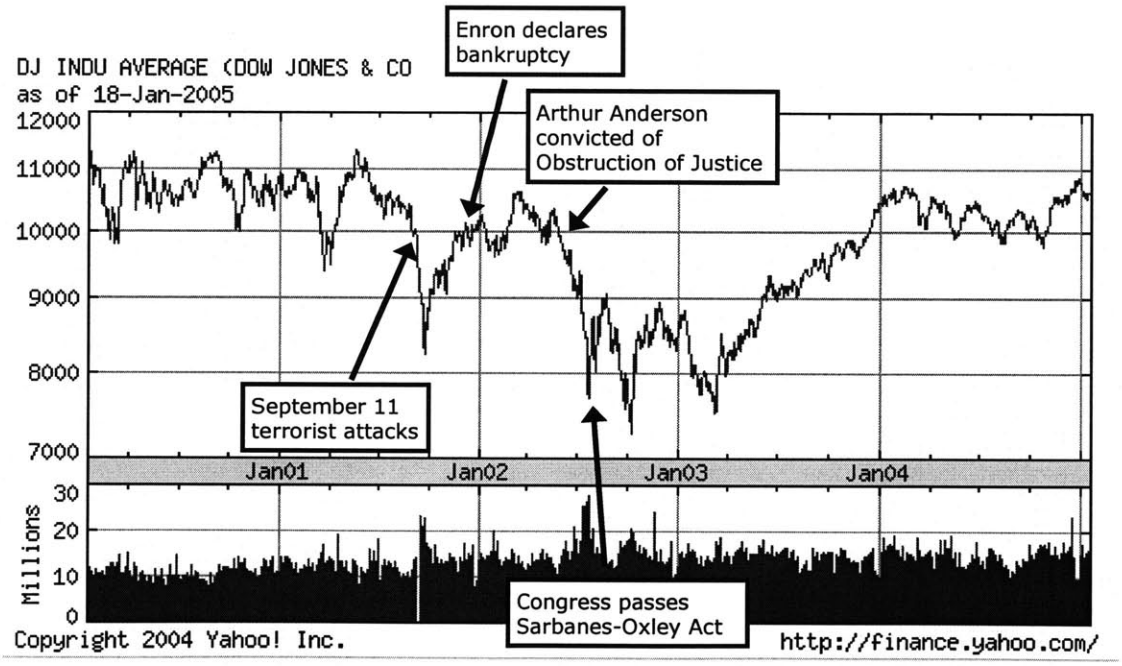


Figure 1: The Dow Jones Industrial Average from 2000-2004. The Enron trials began in early 2002 and continued heavily throughout early 2003. The trials were highly covered by the media, and contributed to the loss of investor confidence in the stock market.

With the market turning to shambles, the government had to step in and put standards back into the practices of corporate governance and accounting. In the middle

of July, 2002, Congress passed the Sarbanes-Oxley Act of 2002. Its stated purpose was, "To protect investors by improving the accuracy and reliability of corporate disclosures made pursuant to the securities laws, and for other purposes" [2]. The Act addressed many of the issues that arose in the Enron scandal, including proper treatment of off-balance sheet transactions, partiality of auditing committees, correct recognition of income, and corporate responsibility for SEC filings. It was clear that the government recognized a need to revolutionize accounting standards in the United States.

Chapter 3 – The Sarbanes-Oxley Act of 2002

The Sarbanes-Oxley Act (a comprehensive summary of which can be found in Appendix A) focuses on four main areas of reform, as described by Chioffi [13]:

1) Corporate governance
2) Disclosures and financial reporting
3) Audit process and oversight
4) Regulation and enforcement

In each area, lawmakers studied the shortcomings of the previous system as exploited by Enron, WorldCom, and the other cases of corruption. The law was written to address each of these areas so that in the future, investors will once again have confidence in the correctness and completeness of the information given in financial statements.

3.1 Corporate Governance

Because of the power that CEO's and CFO's have in overseeing their company's operations and financial reporting, the Act dramatically increases these officers' accountability for the proper reporting of financial statements. Specifically, the Act requires that the CEO's and CFO's of public companies certify in each financial statement that the reporting requirements of federal securities laws are satisfied and that the information disclosed in the reports fairly represents the financial condition of the company. This stipulation holds these officers personally responsible for any fraudulent reporting of information. Indeed, an officer who knowingly certifies incorrect or

misleading disclosures may be subject to a $5 million fine and up to 20 years of prison. In addition, the officers are responsible for maintaining certain internal controls and procedures that ensure the proper collection and reporting of data within the company. They are to report any deficiencies of these controls to the Board of Directors.

3.2 Disclosures and Financial Reporting

The Sarbanes-Oxley Act requires a number of additions and enhancements to be made to the traditional SEC financial reports. First, and possibly most important and relevant to the numerous scandals, is the required disclosure of all material off-balance sheet transactions. Enron used controversial SPE's to remove debt from the company's balance sheet, misleading investors as to the financial state of the company. By forcing all off-balance sheet transactions, SPE's and otherwise, to be disclosed, Sarbanes-Oxley enforces the notion that financial reports give an adequate picture of a firm's financial health. The required disclosures include a statement of the nature and business purpose of the off-balance sheet transactions, the financial impact of the arrangements, and an explanation of any changes from the previous year. Contractual obligations must be placed in a table specifying how much money is committed over the course of the year. A sample table is shown in Table 1. Finally, to fully comply with the Act, these disclosures must be made in a timely manner, reflecting accurate data for the time period covered in the report [3].

Contractual Obligations	Less than 1 year	1 to 3 years	3 to 5 years	More than 5 years	Total
Purchasing Obligations	$125.4M	$76.2M	$0	$0	**$201.6M**
Long-Term Debt	$0	$15.0M	$21.1M	$25.6M	**$61.7M**
Operating Leases	$12.3M	$7.6M	$5.5M	$25.4M	**$50.8M**
...					
Total	**$137.7M**	**$98.8M**	**$26.6M**	**$51.0M**	**$314.1M**

Table 1: Example of required disclosures of contractual obligations.

In addition to disclosing off-balance sheet transactions, the Act requires companies to include in their filings an internal control report, which affirms the management's responsibility for maintaining that financial reporting procedures are properly followed. Also, the internal control report must evaluate the effectiveness of the mechanisms used to maintain these controls. Because of its vague, open-ended wording, this provision has been one of the most debated and costly in the entire Act, with compliance efforts costing companies up to 3% of revenues [14]. While the Act suggests that companies put forth a best effort in establishing controls, it gives no metrics or guidelines as to what extent they must comply with this portion of the Act. Companies have spent significant amounts of time and money defining what "control procedures" mean for their business and establishing such procedures in their day-to-day work.

3.3 Audit Process and Oversight

One major issue that arose during the scandals was the need for auditing firms to be truly independent and impartial. The Securities Exchange Act of 1934 requires all public companies to hire independent auditors to review their financial statements [15].

A serious conflict of interest arises, however, as auditing firms are hired and paid by the companies whose financials they are auditing. Before Sarbanes-Oxley, it was all too tempting for an auditor to overlook discrepancies in a company's financial statements for fear of losing that company as a customer. In the case of Enron, one of Arthur Anderson's largest clients, the auditing firm could not afford to risk aggravating the client by blowing the whistle on nontraditional accounting techniques.

One of the goals of Sarbanes-Oxley, therefore, was to increase the impartiality of auditing firms. The Act accomplishes this by establishing the Public Company Accounting Oversight Board (PCAOB) and by tightening the rules of what tasks auditing companies can perform. The PCAOB's role is to oversee, regulate, and insure impartiality of the actions of independent auditing firms. In addition, the Act prohibits auditing firms from engaging in non-audit services such as financial bookkeeping, designing financial information systems, actuarial services, and investment banking services. The purpose of this provision is to restrict the interaction between public company and auditor to only auditing services in order to limit the development of any additional conflicts of interest.

3.4 Regulation and Enforcement

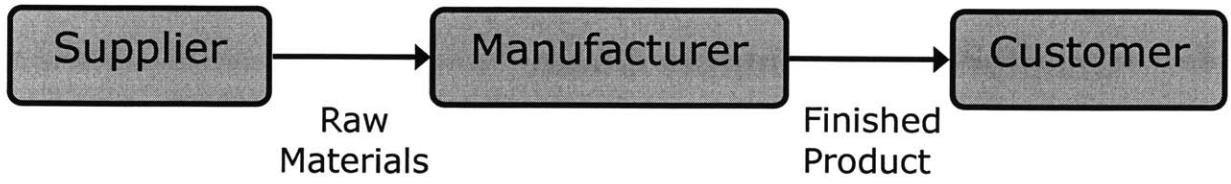
The Act, along with the Corporate and Criminal Fraud Accountability Act of 2002, amends criminal law by specifying a number of accounting and disclosure related punishable offenses. First, it deems to be a crime knowingly destroying, altering, or concealing records with the intent of influencing a federal investigation. Second, CEO's

or CFO's that falsely attest to the soundness of their financial statements may face up to a $5 million fine and 20 years in prison. Also, the Act protects whistleblowers by making it a crime to take any harmful action against anyone providing truthful information to authorities.

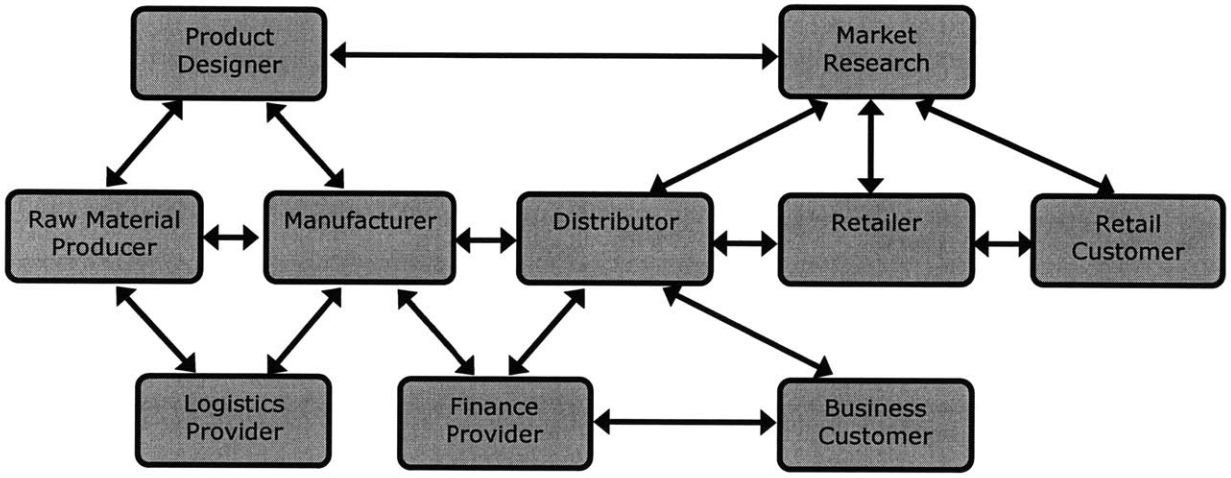
In addition to creating, enhancing, and better defining punishments for fraudulent offenses, Sarbanes-Oxley provides for an increased enforcement of those punishments. The creation of the PCAOB will lead to stricter rules and quality control over audit reports. Also, the Act stipulates that the SEC will review disclosures of public companies listed on the NYSE, AMEX, and Nasdaq on a frequent and systematic basis in order to ensure that the laws are being followed. Unlike Enron, public companies will no longer be able to conceal creative and unlawful accounting techniques, or to have them slip by unnoticed.

Chapter 4 – The Supply Chain

While the Sarbanes-Oxley Act focuses on ensuring proper disclosure and regulation of financial statements, it has a number of direct implications in the day-to-day operations of the company. One of the Act's most interesting applications is its impact in the supply chain. A company's supply chain is the backbone of its operational processes. Entire fields of study have been created and numerous textbooks have been written to study the supply chain and its effect on business transactions and profitability. For simplicity, I break down the supply chain into seven distinct processes: plan, source, produce, store, sell, transport, and return. While there are many different participants in a typical supply chain (see the supply chain modeled in Figure 2(b)), this analysis focuses on a manufacturer, and each process is be described from the manufacturer's point of view. In addition, for the purpose of this research, referring to the supply chain as a simplified model (as in Figure 2(a)) is sufficient.



(a)



(b)

Figure 2: Supply chain structure. In (a), a very simplified structure is shown, highlighting the flow of materials from source to destination. In (b), a highly complex supply chain is shown [16].

4.1 Supply Chain Processes

Each of the seven processes involved in the supply chain uses distinct methodologies associated with it. Some have more emphasis on organization, some on technology, and some on finance and accounting. However, each process is critical to ensure proper operation and to maximize throughput in the supply chain.

To illustrate how many of the processes are handled in an actual company, I conducted an interview with Mr. Brandon Duncan, a Purchasing Agent at NASSCO, the North American Steel and Shipbuilding Company. NASSCO, a subsidiary of General Dynamics, builds ships both for the Navy as well as for commercial uses, such as oil

companies [16]. Although the products it manufactures are unique, a number of its operations in the supply chain are typical for a manufacturing company, and it therefore offers a great case study. Many of my findings are integrated among the discussion of the supply chain processes, demonstrating how each is carried out in a manufacturing company.

4.1.1 Plan

In the planning phase, manufacturers use different techniques and tools to forecast the demand for their product. In perfect supply chain operation, manufacturers would know precisely how much product to make and sell, leaving no unsold units and no excess demand. Knowing this value would allow them to order just enough parts from their suppliers, hire the perfect amount of labor, and not leave any wasted cost on the table. Unfortunately, forecasting demand is not that simple. Depending on the product, demand might increase or decrease due to new products on the market, changing trends in consumer preference, or even the weather. Ultimately, it is very difficult to predict the future demand for most products in the market.

In order to forecast demand, manufacturers use a number of tools to best predict the future. The most common technique is the time series method in which historical trends are analyzed. By looking at how much a product has sold under similar conditions in the past, companies can assume similar trends in predicting the future. As no two time periods are exactly alike in terms of economic atmosphere, the time series method cannot be used as a perfect predictor of demand. In order to take into account new and future

circumstances, companies use causal methods of forecasting that assumes demand is related to certain market factors, such as interest rates or prices. Usually, companies combine time series and causal methods to simulate consumer behavior in an attempt to plan for the future.

Demand forecasting at NASSCO is much simpler than at other manufacturing companies. Because NASSCO's products (ships) are large, expensive, and take months to build, NASSCO begins designing and building only after an order is placed [16]. Therefore, their planning phase involves much more interaction with marketing in order to ensure that historical sales rates are continued. While NASSCO is unusual in that it sells before it produces, it is important to understand that the planning phase still exists, albeit in a different form.

Once demand is forecasted, a company has to decide how to meet that demand. Companies can choose to produce exactly enough product to satisfy the demand, level out production to account for rapid changes in demand, or overproduce in order to use inventory and backlogs to match demand. Depending on the company's production capacity, storage space, and demand curve, different methods of satisfying demand may seem more advantageous than others.

In addition to forecasting and meeting demand, the planning process also includes setting prices, order quantities, and inventory levels. Depending on how they choose to make their product available to consumers, manufacturers can have a huge impact on profits.

4.1.2 Source

Sourcing is the process of procuring materials and services necessary for a manufacturer to produce its goods. Purchasing goods requires four main sub-processes: consumption management, vendor selection, contract negotiation, and contract management [17]. Figure 3 shows how each of these activities interacts throughout the sourcing process.

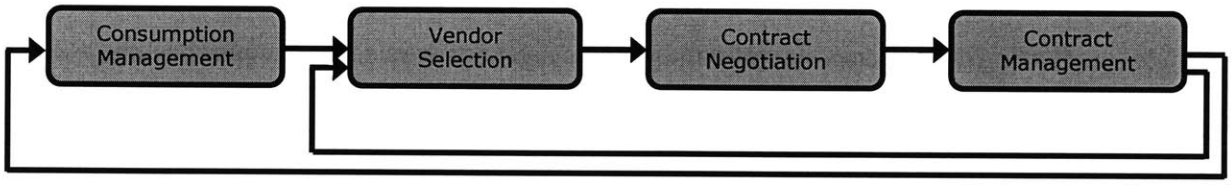


Figure 3. Feedback in the procurement process of the supply chain. This shows the importance of good contract management, which feeds back into both consumption management and vendor selection tasks.

4.1.2.1 Consumption Management

Sourcing begins with an analysis of what is needed for a manufacturer to produce its goods. This analysis is known as consumption management. Before anything can be purchased, a company must know what materials and services, and how much of them, it needs. Consumption above or below expectations could cause the manufacturer to lose a lot of time, money, and opportunities.

At NASSCO, the planning department takes the building schedule, building capacity, and list of materials from the engineering drawings and determines how much materials are needed for a given project. In addition, NASSCO may elect to purchase and store additional materials for economic reasons. For example, if steel prices are

known to rise in the future, NASSCO will stock up on steel, which can be used for future projects [16].

4.1.2.2 Vendor Selection

Depending on the goods and services required, a company will select its vendors with the goal of minimizing the number of suppliers it does business with. This will give the manufacturer purchasing power it can leverage to negotiate lower prices in return for purchasing a higher volume of goods. Once a vendor is selected, the purchasing department begins to negotiate a contract.

NASSCO's purchasing department maintains a list of suppliers for each material. When large orders need to be placed, the vendors are asked to quote a price. Typically the lowest quote will win the contract, but often local distributors are preferred for personalized services and offsite warehousing. Due to the specificity of many of NASSCO's orders, however, materials are sometimes only sourced by a single vendor. For these situations, NASSCO is typically the vendor's largest client, so it is mutually beneficial for the supplier and manufacturer to maintain a good relationship [16].

4.1.2.3 Contract Negotiation

Purchasing contracts stipulate every possible agreement made between the two entities. The stipulations include the duration of the contract, prices at which the goods will be sold, minimum orders that must be made, how shipments will be delivered, when

the contract can be dissolved, and many more. The purchase contract lays out the protocol by which companies and suppliers exchange goods and payments [18]. A sample purchasing contract is shown in Appendix B.

4.1.2.4 Contract Management

Once a contract is written and signed, the manufacturer must continue to measure the supplier's performance against the contract stipulations. Because of the intense competition in the market place, it is necessary for companies to be sure that they are getting the total value out of their transactions. Suppliers that are not fulfilling their end of the bargain should be notified and held accountable. In order to practice reliable contract management, companies must have the ability to track supplier transactions, and to cross check performance against the purchase contracts. Results from contract management and analysis can be used to reevaluate procurement requirements as well as influence vendor selection, as seen in Figure 3.

Contract negotiation and management is handled by the purchasing department at NASSCO. The department is audited typically three or four times a year, from many different sources, both externally and internally. Internal cost engineering audits are geared towards ensuring that vendors are continuing to provide the best services available to NASSCO [16].

4.1.3 Produce

In order to produce their goods, manufacturers first must design and develop the product. Design costs can amount to over 50% of the products costs, so careful research and development is crucial in order to compete [17]. When designing a product, companies try to simplify the design by minimizing the number of parts, production time, and ease of storage. The more versatile and easy to manufacture a product is, the easier it will be to ride the ups and downs of the fluctuating demand.

In addition to product design, a manufacturer must decide how to allocate its facilities during production. Determining where to build plants, how to use the plants, and how many products to make on each production run are all questions that need to be answered in the production phase of the supply chain process.

At NASSCO, the production phase begins in the engineering department as ship designers work closely with the customer to customize the product. Because it takes months or even years for ships to be built, facility allocation is typically straightforward, as there will only be a few projects occurring at a time [16].

4.1.4 Store

As mentioned in the planning process, because demand is not constant, it is often necessary to overproduce goods in anticipation of high demand in the future. Because these goods cannot be sold immediately, they must go into storage. Inventory management is a crucial step in the supply chain, because the longer a company has to

hold goods in storage, the greater the lag between money spent and money received, and the greater the chance that their inventories will become obsolete and go unsold. These issues, along with the fact that holding and maintaining large storage facilities is expensive, lead to the conclusion that holding inventories costs companies a lot of money. In order to find a balance between planning for future demand and minimizing stored inventories, companies are very attentive to where, how, under what circumstances, and for how long excess goods are stored.

4.1.5 Sell

Sales are typically made subsequent to an advertising and marketing campaign. Depending on the industry and the competition, companies may get by with simple word of mouth advertising, or they may need massive marketing attacks. Typically, companies will have a separate division devoted solely to marketing in order to make their name and product known to customers.

Once a customer learns about the product and wishes to place an order, the sale transaction begins. First, the customer submits purchase order that provides the details of what is to be ordered, including item ID numbers, order quantities, and requested delivery date. Upon receiving the order, the manufacturer creates a pick ticket, a packing list, and an invoice. Then, using these documents respectively, orders are filled, items are shipped, and the customer is billed. The process of turning a purchase order into a completed sale is known as order management.

Once an order is fulfilled and the invoice is sent to the customer, the final step in the sale is the payment. Until payment for the goods is received, the manufacturer is essentially making a loan to the customer. A long lag time between delivery of goods and the payment for those goods can cost the company large sums of money. Companies must be in charge of monitoring their customers' accounts, sending out reminders for overdue bills, and renegotiating payment schedules if necessary. Deciding on a credit policy and a collections practice is a crucial step in maintaining the financial health of a company.

At NASSCO, sales are typically the result of a bid-off between competitors. NASSCO has a marketing team that focuses on advertising and attracting customers. In addition, they make sales pitches to customers that are looking to make a large purchase. For NASSCO, winning a bid can mean millions of dollars in revenues, so they put a lot of emphasis on this supply chain process [16].

4.1.6 Transport

Once goods have been ordered, the manufacturer must determine how to deliver them to their destination in the most efficient manner. In order to do this, companies first have to decide where to hold their inventories to ready them for shipment. Large companies with many products and multiple storage facilities in different locations might decide to use a distribution center, where truckloads of individual goods are taken and housed to fill orders. One technique called crossdocking, popularized by Wal-Mart, involves truckloads of single goods that arrive at a distribution center, are immediately

unloaded, broken down, and reloaded onto other trucks that, when full, will deliver their load of multiple goods to the customer (or retailer). Crossdocking saves a lot of time and money, as goods flow faster through the supply chain, little inventory is held in storage, and handling expenses are minimized.

Delivering shipments to customers efficiently can be a daunting task, especially for a large company with thousands of orders to fill each day. If an order is smaller than a truckload, it does not make sense to use an entire truck to make that single delivery. Thus, often trucks are filled to make multiple deliveries on a single route. In order to determine the most efficient delivery schedule, companies often make use of software programs that utilize mapping features and artificial intelligence to determine routes. Depending on the constraints placed on the problem (such as truck size, time constraints, truck temperature constraints, or storage warehouse locations,) different software packages and techniques may be more useful than others. Because of the complexity of the delivery schedule, in order to ensure efficiency and accuracy in the system, it is crucial that companies keep track of what items are being shipped on what trucks at what times.

Because of NASSCO's unique product, delivery to many locations is not an issue. However, on-time delivery is crucial as a number of costs are typically associated with late delivery. In addition, as long as a completed ship stays docked, no other projects can begin in that space. As a result, delivery can be a very costly issue if not handled properly [16].

4.1.7 Return

The final process in the supply chain is returns. After products have been sold and delivered, inevitably some customers will want to return the product. Every product that gets returned costs the manufacturer money, as shipment expenses are lost and repackaging and restocking fees will have to be incurred to sell the item again. Because of this, companies try their best to reduce the return rate, or the percentage of sales that are returned. Increasing quality control in the design and production phase reduces the amount of faulty items produced. Better customer service in the sales process encourages customers to keep products they might otherwise have returned. More control and oversight in the transportation process ensures that goods are not misdelivered or damaged during shipping. These are just examples of how many of the supply chain processes can be improved in order to minimize the return rate.

Chapter 5 – Sarbanes-Oxley in the Supply Chain

Studies in the supply chain deal predominantly with companies' day to day operations. It is these daily tasks, however, that provide the base for the higher level vision and strategy developed by the company executives. For example, an executive officer must have confidence in the production and sales processes in order to make the decision to expand the company to a new location. In much the same way, the Sarbanes-Oxley requirements, which appear to affect only the high level authority of a company, actually reach far into the operations of the supply chain. The two sections that most directly affect supply chain operations are sections 401 and 404 of the Act. Section 401 requires companies to disclose all off-balance sheet transactions. Many of the contracts and transactions that occur in the supply chain do not affect the current period's balance sheets, and thus are considered "off-balance sheet transactions". Section 404 of the Act requires management to maintain an internal control system designed to ensure accurate, complete, and timely processing, recording, and summarizing of the information required to be disclosed in the reports. In addition, officers must assess and evaluate the effectiveness of this control system. Many of the processes in the supply chain relate directly to the financial statements, and as a result, these processes are at the heart of financial reporting. Therefore, a requirement to maintain internal control systems ensuring accurate reporting must significantly affect operations in the supply chain. In the following sections, each of these stipulations and its effect on the supply chain are discussed in detail.

5.1 Section 401 – Off-Balance Sheet Transactions

Section 401 of the Act mandates that "Each annual and quarterly financial report required to be filed with the Commission shall disclose all material off-balance sheet transactions, arrangements, obligations, and other relationships of the issuer with unconsolidated entities or other persons..." [2]. In the Act itself, the meaning of "off-balance sheet transactions" is left vague. However, effective April 7, 2003, the SEC released a Final Rule clarifying a number of discrepancies from the Act, including a definition of terms. The Final Rule defined "off-balance sheet transactions" as any contractual arrangement that specifies:

- Any obligation under certain guarantee contracts;
- A retained or contingent interest in assets transferred to an unconsolidated entity or similar arrangement that serves as credit, liquidity or market risk support to that entity for such assets;
- Any obligation under certain derivative instruments;
- Any obligation under a material variable interest held by the registrant in an unconsolidated entity that provides financing, liquidity, market risk or credit risk support to the registrant, or engages in leasing, hedging or research and development services with the registrant [19].

While the final three parts to this definition deal mainly with high level financial structuring, the first part of the definition applies directly to the supply chain. "Certain guarantee contracts" means any contract that guarantees the exchange of money or assets in the future. In the supply chain, purchasing contracts that stipulate future obligations are examples of this. An example of this is shown in the sample contract of Appendix B. Here, Adams Granite Co. has agreed to buy a minimum of $3 million worth of headstones from Rock of Ages Corporation per year for the next 7 years. Because the

transfer of assets will not take place until the future, companies do not record the transaction on their balance sheet. As long as the contractual obligations are for future financial recording periods, they traditionally would not show up on the balance sheet. Now, under the Act, all current and future monetary effects of these contracts must be spelled out in detail in the annual report. Specifically, companies must place all contractual obligations in a table specifying future financial obligations, an example of which is shown in Table 1 in section 3.2.

5.2 Section 404 – Controls and Procedures

A second and possibly more critical implication of the Act is outlined in Section 404. This section requires management to control and document effectiveness and efficiency in their operations and financial reporting. Management must not only implement and maintain controls and procedures to ensure the proper handling of all asset transactions, but also evaluate the effectiveness of these controls. As Table 2 shows, every process in the supply chain heavily influences some part of the company's financial statements. In fact, the day to day operations of the supply chain directly determine many of the values that appear in the balance sheet, income statement, and other financial disclosures. In order to determine what tools are most useful to ensure effective financial reporting, we must first understand how each of these line items is collected in each of the supply chain processes.

Supply Chain Business Process	Supply Chain Transaction	Financial Reporting Elements (Balance Sheet)	Financial Reporting Elements (Income Statement)
Plan	Demand forecasted Prices set	• Raw materials • Accounts payable • Cash and debt	• Cost of sales
Source	Purchase of equipment, direct and indirect material, and services	• Property and equipment • Accounts payable • Cash and debt	• Depreciation • Taxes
Produce	Products are manufactured or raw materials are converted	• Raw materials • Work in process • Accounts payable • Accrued expenses • Wages payable • Cash	• Cost of sales • Wages • Utilities
Store	Raw materials, work in process, or finished goods are stored	• Raw materials • Work in process • Finished goods • Accounts payable • Accrued expenses • Wages payable • Cash	• Cost of sales • Wages • Utilities
Sell	Products or services are sold	• Accounts receivable • Finished goods • Warranty reserves • Commissions payable • Cash	• Net revenues • Cost of sales • Selling expenses • Marketing expenses • Commissions
Transport	Goods are transported	• Work in process • Finished goods • Accounts payable • Wages payable • Cash	• Cost of sales • Wages
Return	Sold goods are returned	• Accounts receivable • Inventory reserves • Accounts payable • Warranty reserves • Commissions payable • Cash	• Net revenues

Table 2: Accounting implications of supply chain processes [20].

5.2.1 Plan

In the planning phase, the company uses past sales trends to forecast current demand. For this, accurate sales data is needed. The company must have the ability to break down sales information by time period, customer demographics, location, product ID, and any other category of interest. In addition, current inventory levels and production capacities must be known precisely in order to determine how to meet the forecasted demand. In order to most efficiently and effectively use planning in the supply chain, companies need accurate, real time *item level* information for the most fine-grained analysis.

5.2.2 Source

Sourcing and procurement of raw materials requires a high attention to contract management. To best record inventory levels, companies should be able to further categorize raw materials to reflect the purchases made through their purchasing contracts. Ideally, for each raw material in their production facilities, companies should know the item's origin and arrival date. This information would allow the manufacturer to properly document its inventories as well as understand how much of each contract obligation has been filled. In addition, to ensure proper financial reporting, payments for goods should be linked to the arrival of the goods themselves. This one-to-one relationship would eliminate the possibility of double counting or omitting purchases from the financial statements. In sum, while planning requires item level information,

sourcing requires a database of different types of information for each product, depending on the industry and company requirements.

5.2.3 Produce

During production, a fundamental change occurs in the financial statements. What begins as raw materials ends up as work in process and inventories. In order to ensure that this transition is correctly reflected on the financial statements, companies need a system to track inputs and outputs in their production process. Like in sourcing, this system should ideally be linked directly to the line items of the financial statements, so that this process can be performed automatically upon production of the finished product. In addition, the tracking system should be adaptable, with the ability to track inputs as separate items before production but track the manufactured good as a single product after production, as shown in Figure 4.

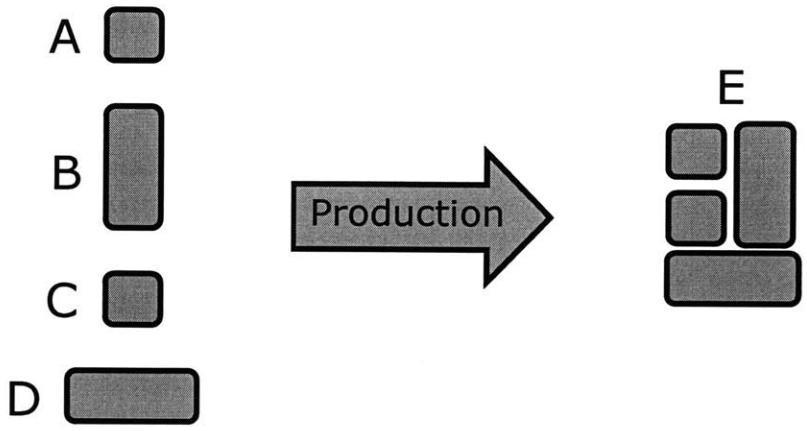


Figure 4: Item tracking before and after production. In an ideal tracking system, items tracked individually (A, B, C, D) before production must be tracked and recorded as a single good after production (E).

5.2.4 Store

Item storage, like sourcing, requires a specific attention to what products are currently in inventory, what percentage of warehouse capacity is being utilized, and the exact location of every good in storage. When goods are taken out of storage, the tracking system must be updated reflecting the new location of the good (whether it is sold or moved to a different warehouse) and the newly available space in the storage facility. The financial statements should reflect this change automatically, updating products status as they are moved into and out of inventory.

5.2.5 Sell

Order management is critical to the sales process in the supply chain. When an order is placed, it should be linked directly to the goods requested in the purchase order. Thus, any individual purchased item can be traced back to its purchase order, pick ticket, packing list, and invoice. When sales are made, linking the sold items to the order should also automatically adjust the relevant financial statement items, such as incrementing accounts receivable and decrementing inventories. Upon payment, the paid invoice should also link back to the specific items, adjusting the financials in a similar fashion.

5.2.6 Transport

Item transportation requires a significant amount of tracking. Ideally, goods are delivered at their destination in the exact condition that they left the warehouse.

However, due to a number of factors, this is often not the case. During transportation, goods can be broken, mis-delivered, lost, or otherwise go unaccounted for. Some items, such as produce or certain electronics, must be kept at specific temperatures and can spoil or lose functionality if subjected to heat or cold. Upon delivery, many man-hours are wasted ensuring that the products delivered are in fact the products that were ordered. Efficient tracking and sensing systems need to allow for fast and easy item recognition. Current systems, such as bar coding, require too much time and effort to scan each individual item. Thus, only full pallets are usually scanned and manually inspected. This greatly decreases the granularity of information, and in turn requires human intervention to manually check each delivery. Certainly the transportation stage of the supply chain will benefit significantly from a tracking system aimed to maintain controls over accounting to comply with the Sarbanes-Oxley Act.

5.2.7 Return

Like sales, returns must also link to the financial statements. A returned item should trigger changes in inventory, accounts payable, and any other affected account. The specific item can also be tracked to ensure that the item returned was indeed the item purchased, and no alterations to the item have been made.

5.3 Requirements for Sarbanes-Oxley Compliance

With the goal of setting up a control system to comply with Sarbanes-Oxley, we can now enumerate the requirements for a tracking system in the supply chain. Based on the applications and ideal use of such a system in each process of the supply chain, the system must have the following properties:

- **Item-level information** – A high granularity must be achieved so that individual items can be tracked separately.
- **Information depth and adaptability** – Different types of information must be able to be stored for each item, depending on the requirements of the user.
- **Read/write capabilities** – The tracking system must allow information to be read from as well as written to in order to update items and keep track of the items' history.
- **Ability to link to documents and financial statements** – Changing items' information or classification must automatically link to other related documents and the financial statements.
- **Efficient and easy to use** – In order for the tracking system to be feasible, manipulating and overseeing the system must be fast and easy to use.
- **Relatively inexpensive** – In order for the system to become prevalent, its benefits must outweigh its costs.
- **High accuracy of information** – The system must be highly accurate, producing data that users can trust.

- **Longevity** – The system must not have a limited lifetime or degrade over time.
- **Standardization of use** – For the system to be widely used, the details must be standardized to allow compatibility users at any location.

In the following section, I will describe how Radio Frequency Identification (RFID) technology can fulfill each of these requirements, and act as a tracking system that will render companies more efficient and help them comply with Sarbanes-Oxley.

Chapter 6 – Radio Frequency Identification

Like its predecessor, the barcode, RFID is a form of Automatic Identification and Data Capture (AIDC) that utilizes readers to read tags placed on individual items. However, RFID is much more versatile than the barcode, and thus can be used in a wider range of applications. For example, unlike barcodes that require line of sight to be read, RFID tags can be read through objects, from meters away, and in harsh conditions. In addition, some forms of RFID technology allow information to be written to the tag, allowing the tag to operate as a local store of information. RFID systems have begun to be deployed in many industries and applications requiring the tracking of objects. Access control, automated toll collection, and livestock management are all examples of how RFID has been used to make information tracking processes more reliable and efficient [21]. In addition, I show here that RFID is powerful enough to act as the backbone of a system designed to comply with Sarbanes-Oxley. In Chapter 6, I enumerated the qualities needed in a tracking system in order to maximize efficiency and comply with the Act in the supply chain. In this chapter, I review those qualities and show how RFID can fulfill them. In the following chapter, I describe how RFID is currently used in the supply chain and discuss the feasibility of RFID as a standard for Sarbanes-Oxley compliance.

6.1 Item-Level Information

In the past, the prevailing tracking system has been the barcode. Used on nearly every commercial product, the barcode allows for generic item identification. By generic, I mean that two items of the same product, for example two 12 oz. bags of Original Lays Potato Chips, will have the same barcode. Thus, it is easy to identify the item's manufacturer and product type, but there is no way of distinguishing between two individuals of the same product code. RFID, on the other hand, has the ability to encode item-level information. Thus, an RFID system would be able to distinguish between a 12 oz. bag of Original Lays Potato Chips that has been on the shelf for two days and one that has been there for two years. This capability makes RFID a much more powerful tracking system than the barcode system.

6.2 Information Depth and Adaptability

The ability to handle item-level information stems from the fact that RFID can hold much more information than can a barcode. Figure 5 shows a sample barcode.

Figure 5: The barcode structure. A barcode consists of bars that encode a product number, but contain no product-specific information.

The lines in the figure are a simple encoding of the number written below. The lines allow scanners to read the barcode so the product number does not have to be entered manually. The number itself does not contain any descriptive data. When scanned, the barcode's number links to a computer system holding information about that product, such as price, vendor, and quantity in stock [22]. While the computer system can hold a plethora of information, the barcode is limited by the amount of data it can hold.

Until 2005, barcodes used on retail items contained 12 digits. This meant that up to 12^{10}, or about 62 billion, unique product codes can be encoded by the barcode. Starting January 1, 2005, however, the Uniform Code Council (UCC), the governing body of UPC and barcode standards, adopted the Sunrise initiative, changing the barcode standard from 12 to 13 digits. As the number of products has grown, the number of available codes has shrunk. The UCC needed to increase the number of digits to comply with global standards as well as allow a larger number of products to be used in the barcode system [23]. Adding an extra digit allows 76 billion more products to be registered.

RFID systems, however, can encode up to thousands of bits of information [21]. (For comparison, a 13 digit capacity on new barcodes corresponds to 37 bits of information.) This allows RFID tags to encode actual data about the product, not simply a unique identification number. Because of this, high capacity RFID tags do not necessarily need to be linked to a central computer system in order to function. This makes RFID far more versatile than the barcode, as its use is not restricted to a specific locality. For example, if a cashier was to scan the barcode on a bottle of water at a supermarket, the information retrieved by the computer system would be completely

different than if he brought the bottle of water to the supermarket next door and scanned in the same item. If instead of a barcode, the supermarket used RFID tags, the reader at each supermarket would retrieve the same information from the tag. The large capacity of the RFID tags allows each tag to store a large amount of specific information about the product. Depending on the users' needs, all types of different information can be linked to the specific product. In this manner, an RFID system can not only hold a lot of information about each product, but the type of information can be very diverse and adaptable.

6.3 Read/Write Capabilities

While barcodes are printed and thus immutable (and therefore read-only), RFID tags are transponders that consist of a microchip that stores the data. There are many types of RFID tags, including read/write tags that allow users to mutate the data stored in the microchip an unlimited number of times. This allows users to update information on the tag, maintaining a log of item history. In addition, writeable tags can be reused, significantly reducing their cost per use [21].

6.4 Document Linkage

An important feature of an RFID system is its data processing system. The data processing system is a back-end database that contains detailed information about each product, indexed by its RFID code. Thus, when a tag is read, the ID is referenced to the

data processing system, and all relevant information corresponding to that ID is retrieved. The most versatile capability of the data processing system is the ability of software applications to piggyback the system in order to make use of the data. For example, a statistical program can query the data processing system in order to collect and display data regarding average shipping times to a specific location. Or, a customer management program can query the data processing system to email frequent customers, letting them know when a specific item has arrived in stock. The ability of customizable software programs to utilize the unique item level information contained in the data processing system is critical in allowing an RFID system to link to other applications. Using the software application layer, an RFID system can link directly to the financial statements, fulfilling the document linkage requirement for a system to comply with Sarbanes-Oxley.

6.5 Efficiency and Ease of Use

In addition to the microchip which stores the data, RFID tags contain an antenna that sends and receives information via radio frequency waves. An RFID tag reader, or transceiver, detects radio waves and sends the data stored within the waves to the data processing system. The transceiver can detect radio wave communications by passive RFID tags from up to about 10 meters away, and do not need to maintain line of sight in order to detect the waves [21]. Thus, tags can be read through objects, in hostile environments, and at a significant distance from the reader. Another benefit of the transceiver is that it can receive multiple signals at once. Unlike barcode readers, which can only interpret one tag at a time, RFID transceivers can handle multiple tags at once.

Imagine being in a supermarket where all goods have RFID tags. Instead of going through the checkout and having to take out all the items to be scanned one by one, the cart is simply rolled under a transceiver and immediately all the items show up on the computer screen. The applications that stem from the efficiency of the RFID system are endless.

6.6 Relative Cost

In order for widespread use of RFID to be possible, the benefits of the system must outweigh the costs. For each industry and application, this might mean different things. Therefore, it is hard to say how cheap an RFID system must be in order to be worthwhile. However, we can take a look at the current cost numbers to get a rough estimate. There are four types of costs that arise in setting up an RFID system: tags, readers, infrastructure, and maintenance.

6.6.1 Tags

Currently, depending on its size and capacity, each tag could cost anywhere from $0.20 to a few dollars. The specific application of the tag, whether it is used on a per-item, per-pallet, etc. basis, will decide what type (passive vs. active, capacity, etc) and how many tags a company will need to use. One important metric is the cost of the tag as a percentage of the good's total cost. Another is the cost of the tag as compared to the incremental benefits obtained by using it. For example, it may not make sense for a

paper manufacturer to tag each loose-leaf piece of paper in a ream, but it might be reasonable for each ream (or at least each case of reams) to be tagged. Also, as technological advancements continue, tags will become smaller, more efficient, and easier to manufacture. In addition, more suppliers will enter the market, creating more competition. These phenomena will drive down the cost of the tags even further, making RFID applications more worthwhile and feasible.

6.6.2 Readers

RFID readers currently cost anywhere between $100 and $40,000, depending on the size, signal strength, read/write capabilities, and speed. If placed in strategic locations, the number of readers necessary can be minimized, as a single reader can handle a large number of reads at a time. In addition, the cost of the readers is a one-time fixed cost, and will require minimal maintenance over the course of its lifetime.

6.6.3 Infrastructure

Typically, companies wishing to set up an RFID system will do so by outsourcing an RFID integration consultancy that focuses on helping companies build the infrastructure necessary to support an RFID system. Consultancy fees can be fairly costly depending on the size and applications of the system rollout. In addition, server hardware, wiring, antenna integration, power supplies and backup must be purchased and installed. Once the physical infrastructure is in place, RFID software must be either

purchased (if the applications are common) or developed (if the applications need to be customized for the company). Licensing for software usage can also be quite expensive. However, infrastructure costs are also fixed costs, and once in place, will not require much maintenance costs.

6.6.4 Maintenance

In order to maintain a reasonably sized system, at least one full time employee will be necessary, depending on the system's size. This employee would be in charge of keeping readers and the system up to date and functioning properly. As noted in section 6.8, however, an installed RFID system should be designed to last forever, and will most likely need to be replaced first out of obsolescence or physical damage rather than degradation. In addition to direct maintenance costs, a significant cost would be incurred to train people to use the system.

6.7 Accuracy of Information

The information that a reader retrieves from a tag is essentially flawless. The main sources of potential errors are missed tag reads and "ghost reads," which refers to a situation when noise in the system is interpreted as a tag signal. Proper system design, packaging, and reader antenna placement minimize and make predictable missed tag reads. Predictability in missing data enables the application systems to utilize the captured data to great benefit. Ghost reads are more nefarious since they introduce

seemingly correct data into the system. However, the technology has become so precise that the chances of having a ghost read are infinitely small [24]. Thus, when a reader reads a tag, it can be assured to have read the correct data.

The largest inaccuracies in the system, therefore, occur when tags are not read. Unfortunately, there is no way to detect an unread tag, because the reader just assumes that nothing is there. In order to reduce the possibility of having unread tags, redundancy must be introduced into the system. For example, consider a pallet containing 24 cases of canned fruit. It is possible that when passed under a reader, only 23 cases register. This could happen for a number of reasons. A tag may have been damaged during shipping, the far end of the pallet may have been too far from the reader or out of its range, the manufacturer may have forgotten to place a tag on one of the cases, or there might actually only be 23 cases on the pallet. In order to determine the true situation, the pallet itself could be tagged as well, with an explanation of its contents. Thus, an automatic check could be in place to ensure that the pallet's contents match up with the individual case data as determined by the reader. In sum, while the system might not be perfect in terms of data collection, errors involved are almost always human errors that can be reduced through built-in redundancy.

6.8 Longevity

An RFID system will typically last far longer than any of the items it tracks. Passive tags require no power source and will last forever unless destroyed. Basically, an

RFID system will need to be replaced due to obsolescence or physical destruction well before any effects of system degradation are realized.

6.9 Standardization of Use

In order for RFID use to be widespread and compatible, usage standards need to be set. It would not make sense for a receiving dock to be unable to scan an item shipped from a supplier because the tags used were incompatible with the readers. Currently, there are many organizations that attempt to standardize the RFID industry on a global level. The main standards organizations are ISO, which develops standards for all manner of technologies and applications, and EPC Global, which standardizes interfaces for middleware and RFID protocols. In addition, IETF and IEEE develop standards for lower level processes such as network communication protocols and low level networking.

Chapter 7 – Current RFID Integration

As of February, 2005, RFID is used mostly for closed loop applications such as toll collections, building access control systems, and animal tracking. While a number of papers have been written about the vast potential of RFID in the supply chain, companies have only begun to integrate RFID into their open loop processes. However, as RFID technology continues to grow and system integration becomes more affordable, RFID systems will become ubiquitous in the supply chain.

7.1 RFID Mandates

Over the last few years, a number of large organizations have begun to require the use of RFID in their operations. These mandates exhibit proof that RFID will soon become a standard in item identification and tracking. Two of the world's largest organizations, the United States Department of Defense and Wal-Mart, have both required their suppliers to tag their shipments with RFID. In the following sections, I describe each of these mandates.

7.1.1 Department of Defense

The Department of Defense (DOD) mandated in 2003 that by January 1, 2005, its newest suppliers must tag all cases and pallets with RFID. The DOD mandates the use of passive ultra-high frequency tags that embrace the Electronic Product Code (EPC)

constructs in addition to the DOD standards. The mandates are extremely specific, detailing which data bits should be used to represent different types of information. In addition to the RFID requirements, suppliers will also have to abide by a set of unique identifier (UID) regulations [25]. According to Major General Daniel Mongeon, U.S. director of logistics operations, the DOD decided to implement an RFID system in order to "Reduce inventory, duplicate ordering and shrinkage" [26].

However, delays in setting up RFID systems have caused many of the DOD's suppliers to miss the January 1, 2005 deadline. In fact, less than half of the DOD's many suppliers currently have developed the capacity to fulfill the request [27]. In addition, a lack of industry standards has caused confusion among the DOD's suppliers and has slowed down the process. However, the DOD is confident that by 2010, all of its suppliers will have phased RFID systems into their operations [25].

7.1.2 Wal-Mart

Possibly the most significant milestone towards integrating RFID in the retail supply chain came in mid 2003 when Wal-Mart, the world's largest company, announced that starting January 1, 2005, its 100 largest suppliers would be required to tag their goods with 96 bit passive RFID tags. Like the DOD, Wal-Mart's suppliers have had similar delays in setting up RFID systems, causing Wal-Mart to reengineer its request. To match market limitations, Wal-Mart downgraded the January 1 deadline to be applied only to a limited set of products from each of the top suppliers. In addition, while it had originally asked its suppliers to tag every individual item, it revised the definition to

require only tagging cases and pallets. Even with the changes, only 40 of the suppliers were able to fulfill the modified request; the others are currently tagging only bulk shipments [28].

7.1.3 Other Retail Mandates

In addition to the DOD and Wal-Mart, many other companies and organizations are beginning to require their suppliers to use RFID. Best Buy issued a mandate that its major suppliers tag all cases and pallets with RFID by January 2, 2006. In addition, Best Buy hopes to have all cases and pallets tagged by May 2007 [29]. Many other retailers such as Target, Albertsons, Metro, and Tesco have issued similar requests of their suppliers. Nokia Corporation is beginning to use RFID in their mobile phones, enabling better connection among enterprise users, especially the service and repair workforce [30]. As large retailers continue to require RFID from their suppliers, the use of RFID systems will trickle down to even the smallest of companies. Before long, RFID systems will become a standard in the supply chain.

7.1.4 FDA Pharmaceutical Tracking

Beyond the supply chain, the benefits of RFID are being realized in many diverse applications and industries. One example is its use in the pharmaceutical industry. In early 2004, the FDA announced that by January 2007, they hope to phase in RFID tagging at the item level for all prescription pharmaceuticals as an anti counterfeiting

measure. Companies such as Purdue have already begun using RFID tags at the item level on certain high value and often counterfeited products such as OxyContin. The main driver is to maintain patient safety and to eliminate counterfeit drugs, in addition to introducing new authentication features into the industry [31]. As RFID continues to be used in diverse applications like these, its prevalence as a global standard for tracking will soon be realized. The Wireless Data Research Group projects that the market for RFID hardware, software, and services will grow from more than $1 billion in 2003 to $3 billion in 2007, a compound annual growth rate of 23% [32].

7.2 Current Road Blocks and Future Outlook

The delays in RFID integration are understandable. First, as explained in Chapter 6, there is a significant startup cost to adopting an RFID system. In addition, RFID use in the supply chain is being pioneered by these companies, so there are no "best practices" to rely on. The small number of RFID providers and RFID integration consultancies causes an even greater barrier to entry, as the lack of competition keeps prices high and efficiency low. Finally, standards are still being developed, so compatibility issues are not completely resolved. While RFID will some day become necessary and ubiquitous in the supply chain, its current use is hindered by the early stages of development of the industry.

Chapter 8 – RFID Impact on Sarbanes-Oxley

As RFID systems become commonplace in the supply chain, it seems logical that companies will want to leverage the use of these systems to help comply with the Sarbanes-Oxley Act. As RFID systems become the norm for Sarbanes-Oxley compliance, however, the fundamentals on which the Act was written will have changed, and thus, the Act itself will require reevaluation.

8.1 Sarbanes-Oxley Fundamentals

As described in Chapter 5, Sarbanes-Oxley's applications in the supply chain are quite qualitative. Most of the Act's wording is vague, requiring companies to set up controls and procedures ensuring the proper collection of data and accurate recording of transactions in the financial statements. Because there are no specific metrics, or other precise guidelines instructing companies how exactly to set up these controls and procedures, the provisions of the Act are presented on a "best effort" basis. From the events preceding the Act (as described in Chapter 2), it is clear that the intentions of Congress in passing the Act were to enforce the accuracy of financial statements in order to increase investor confidence in public companies. However, as each industry and company is run differently and has different values and fundamentals, there is no catch-all formula for preparing financial statements. Holding CEO's and CFO's personally responsible for ensuring the validity of the data in their individual organizations was Congress's way of generalizing the Act to make sense to all companies and industries.

With less than a year of company compliance under the Act's belt, it is yet to be seen how strictly the judicial system will enforce it. For now, it seems as long as companies make their "best effort" to set up controls and procedures to monitor their preparation of financial statements, they should legally be considered compliant with the Act. But, with no precedent from companies brought to trial, it is unclear what defines "best effort" and how far companies can stretch the limits. A clear understanding of how far company executives have to go to monitor proper handling of data and transactions is lacking in the Sarbanes-Oxley Act. Unfortunately, this deficiency will only be amplified in the future as technological advancements in RFID raise the bar of what can be considered "best effort".

8.2 Changes to the Playing Field

With an RFID system, the granularity of data availability becomes much finer. In the past, with barcodes or other tracking systems, only product types and other macro-level information such as truck and warehouse contents could be recorded. With RFID, each item has a unique code, which increases the level of available information from a group of products to an individual product. Suddenly a whole new range of information can be tracked. Obviously, this fine granularity of data can be used to more precisely record transactions and prepare financial statements. In the past, financial statements were inherently rounded off, as the available tracking technology simply didn't make it possible to precisely record inventories, deliveries, and returns. If a case fell off the back of a truck during transit, no one would know whether the missing case was caused at the

loading dock, the receiving dock, or somewhere in between. As a result, financial statement numbers are only approximations. In the future, however, a precise count of products can be performed before and after delivery, so every item can be tracked throughout each of the processes of the supply chain. Every transaction can intrinsically update item-level data, ensuring that at any given time, financial statements precisely reflect the status of products in the supply chain.

With the availability of perfect item-level information, the fundamentals on which the Sarbanes-Oxley act was written no longer fully apply. What once was considered a company's "best-effort" in tracking data and preparing financial statements is now only a mediocre attempt at accuracy. As companies implement RFID systems, their investors will be rewarded with precise and reliable data, while companies still obsolete in their tracking technology will leave their investors unsure. Whether this discrepancy will have any impact on the financial markets is yet to be seen, but it is clear that the advent of RFID will leave a significant impression on the interpretation of the Sarbanes-Oxley Act of 2002.

8.3 Necessary Changes to the Sarbanes-Oxley Act

It is now apparent that the current requirements and wording of the Sarbanes-Oxley Act will have to be updated to reflect advancements in technology and the subsequent raising of the "best effort" bar. Ideally, the government will need to specify precisely what "controls and procedures" for ensuring proper preparation of financial statements means. Although these definitions can differ quite significantly from industry

to industry, it will be imperative for the sake of investors that the government changes the Act's current generalities into tangible specifics.

The Act will also need to be updated to address the effectiveness and acceptability of current Sarbanes-Oxley compliance solutions currently available in the market. Because certain solutions provide more detail, granularity, and precision than others, it is impossible to judge proper compliance based on the amount of effort made by different companies. For example, Company A might be highly concerned about Sarbanes-Oxley compliance, and as a result spends a lot of time and money developing an in-house system to cater to the company's specific needs. However, because this system is proprietary, it does not have the capabilities or granularity of more commercially available systems. Company B, on the other hand, does not care much about compliance and simply spends a bit of money on an all-in-one software solution. This software package is not customizable to the company's business, but provides significant granularity and detail. Given the current wording of the Act, it is impossible to determine which of these two companies made a better (or even acceptable) effort in creating controls and procedures. With more and more products on the market, the government will need to clarify the Act's definitions and requirements.

In sum, it is clear that the advancements made in RFID technology make it an ideal solution for Sarbanes-Oxley compliance. However, as RFID systems become more ubiquitous within the supply chain, companies will have outgrown the operational framework set up by the Sarbanes-Oxley Act. As a result of this new technology, the fundamentals of the Act will have to be reevaluated and clarified in order to maintain the Act's integrity.

Chapter 9 – Conclusions

The many corporate accounting scandals of the early years of the 21st century rocked the financial markets. The significant decline in investor trust in public companies was clearly apparent in the stock market crash. In order to restore confidence back to the financial system and ensure that public companies' financial reports would contain accurate and truthful data, Congress passed the Sarbanes-Oxley Act of 2002.

While the Act pertains to many parts of the corporate process, its applications in the supply chain are quite interesting. Most significantly, the Act requires public companies to set up internal controls and procedures intended to ensure that their data gathering is reliable and that their financial reports are accurate. Unfortunately, the Act does not lay out any metrics or specific criteria with which companies must comply. The Act simply asks for companies to put forth a "best effort" in designing and putting to use these controls and procedures.

Tracking item flow and recording data in the supply chain incurs a number of challenges that a system must overcome if it is to constitute a worthy tool for Sarbanes-Oxley compliance. A system must have high granularity, meaning that it must be able to track products on an item level basis. It must also be able to record large amounts of information, including many different metrics about the item. It should have both reading and writing capabilities for dynamic updates. It should be able to link directly to the financial statements to ensure accurate reporting. It should be efficient, reliable, easy to use, and its benefits must outweigh the costs of implementing the system. Finally, it should be standardized within the industry so as to ensure compatibility among vendors.

One technological tool that fulfills these requirements is Radio Frequency Identification (RFID). Though RFID is currently being developed and deployed in mostly closed loop applications, its use in the supply chain will soon become ubiquitous. Its capabilities and potential benefits are invaluable to companies in high volume industries with tiny profit margins. As RFID becomes commonplace in supply chain operations, its use as a tool for Sarbanes-Oxley compliance is inevitable.

Because RFID introduces the availability of perfect item-level information, the capacity for data analysis is higher than it has ever been before. The availability of this new technology thus brings to question the definition of "best effort" as introduced in the Sarbanes-Oxley Act. As was the case with the Clean Air Act of 1963, the introduction of new technology will soon render the Sarbanes-Oxley Act obsolete. In order to truly address the fundamental problems for which the Sarbanes-Oxley Act was written, Congress must reevaluate the Act in light of the new capabilities that RFID provides.

9.1 Untested Waters

There are two main reasons why these issues have not yet been addressed by Congress or the courts. First, Sarbanes-Oxley is simply too new. For many of the sections, including section 404 (controls and procedures), compliance was not required until March 1, 2004, only a year prior to the writing of this thesis. There simply has not been enough time or data available to evaluate the effectiveness of the wide and diverse range of attempts at compliance made by different companies. In order to have enough data points for comparison, compliance must be set for at least a few years in order for

companies to generate multiple annual reports under the new system. Only then can a thorough evaluation occur on the effects that Sarbanes-Oxley compliance has had on companies' annual reports and stock returns. Until then, it will remain unclear which compliance systems are truly effective at ensuring proper financial reporting and which are less accurate.

The second reason why RFID's impact on Sarbanes-Oxley compliance has yet to be questioned is that RFID technology, while vastly improving, has still yet to become commonplace among fast moving consumer goods (FMCG) manufacturing companies. Numerous actions by large retail firms, such as Wal-Mart's mandate that its suppliers tag their pallets and cases with RFID, have suggested that RFID systems will soon become a standard throughout the supply chain. However, as of now, RFID has mostly been limited to specific applications such as toll collection or livestock management. As pilot programs are evaluated and best practices identified, the benefits of RFID systems will be realized and become tangible. In addition, as the number of RFID suppliers increases, competitive forces will drive down the cost of tags, readers, and infrastructure. When these phenomena occur, the benefit to cost ratio of adopting an RFID tracking system will sharply increase, and all types of firms that operate in the supply chain will find it not only strategic, but also necessary to use RFID in their daily operations. Once RFID systems become more widespread, their effectiveness in complying with Sarbanes-Oxley can be evaluated in the context of the law.

Until the effectiveness of RFID relative to other compliance solutions can be determined and backed up with real data, it is important to preemptively understand the consequences of technological advancements on our financial systems. In the case of

Sarbanes-Oxley, safeguards attempting to ensure investor confidence in public companies may break down as new products reach the market. The assumptions Congress made in passing the Act will cease to be valid, and as a result, the financial markets might suffer harsh consequences.

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Appendix A – Summary of the Sarbanes-Oxley Act

Section 3: Commission Rules and Enforcement.
A violation of Rules of the Public Company Accounting Oversight Board ("Board") is treated as a violation of the '34 Act, giving rise to the same penalties that may be imposed for violations of that Act.

Section 101: Establishment; Board Membership.
The Board will have five financially-literate members, appointed for five-year terms. Two of the members must be or have been certified public accountants, and the remaining three must not be and cannot have been CPAs. The Chair may be held by one of the CPA members, provided that he or she has not been engaged as a practicing CPA for five years.

The Board's members will serve on a full-time basis.

No member may, concurrent with service on the Board, "share in any of the profits of, or receive payments from, a public accounting firm," other than "fixed continuing payments," such as retirement payments.

Members of the Board are appointed by the Commission, "after consultation with" the Chairman of the Federal Reserve Board and the Secretary of the Treasury.

Members may be removed by the Commission "for good cause."

Section 101: Establishment; Duties Of The Board.

Section 103: Auditing, Quality Control, And Independence Standards And Rules.

The Board shall:
(1) register public accounting firms;
(2) establish, or adopt, by rule, "auditing, quality control, ethics, independence, and other standards relating to the preparation of audit reports for issuers;"
(3) conduct inspections of accounting firms;
(4) conduct investigations and disciplinary proceedings, and impose appropriate sanctions;
(5) perform such other duties or functions as necessary or appropriate;
(6) enforce compliance with the Act, the rules of the Board, professional standards, and the securities laws relating to the preparation and issuance of audit reports and the obligations and liabilities of accountants with respect thereto;
(7) set the budget and manage the operations of the Board and the staff of the Board.

Auditing standards. The Board would be required to "cooperate on an on-going basis" with designated professional groups of accountants and any advisory groups convened in connection with standard-setting, and although the Board can "to the extent that it determines appropriate" adopt standards proposed by those groups, the Board will have authority to amend, modify, repeal, and reject any standards suggested by the groups. The Board must report on its standard-setting activity to the Commission on an annual basis.

The Board must require registered public accounting firms to "prepare, and maintain for a period of not less than 7 years, audit work papers, and other information related to any audit report, in sufficient detail to support the conclusions reached in such report."

The Board must require a 2nd partner review and approval of audit reports registered accounting firms must adopt quality control standards.

The Board must adopt an audit standard to implement the internal control review required by section 404(b). This standard must require the auditor evaluate whether the internal control structure and procedures include records that accurately and fairly reflect the transactions of the issuer, provide reasonable assurance that the transactions are recorded in a manner that will permit the preparation of financial statements in accordance with GAAP, and a description of any material weaknesses in the internal controls.

Section 102(a): Mandatory Registration

Section 102(f): Registration And Annual Fees.

Section 109(d): Funding; Annual Accounting Support Fee For The Board.

In order to audit a public company, a public accounting firm must register with the Board.The Board shall collect "a registration fee" and "an annual fee" from each registered public accounting firm, in amounts that are "sufficient" to recover the costs of processing and reviewing applications and annual reports.

The Board shall also establish by rule a reasonable "annual accounting support fee" as may be necessary or appropriate to maintain the Board. This fee will be assessed on issuers only.

Section 104: Inspections of Registered Public Accounting Firms

Annual quality reviews (inspections) must be conducted for firms that audit more than 100 issues, all others must be conducted every 3 years. The SEC and/or the Board may order a special inspection of any firm at any time.

Section 105(b)(5): Investigation And Disciplinary Proceedings; Investigations; Use Of Documents.

Section 105(c)(2): Investigations And Disciplinary Proceedings; Disciplinary Procedures; Public Hearings.

Section 105(c)(4): Investigations And Disciplinary Proceedings; Sanctions.

Section 105(d): Investigations And Disciplinary Proceedings; Reporting of Sanctions.

All documents and information prepared or received by the Board shall be "confidential and privileged as an evidentiary matter (and shall not be subject to civil discovery other legal process) in any proceeding in any Federal or State court or administrative agency, . . . unless and until presented in connection with a public proceeding or [otherwise] released" in connection with a disciplinary action. However, all such

documents and information can be made available to the SEC, the U.S. Attorney General, and other federal and appropriate state agencies.

Disciplinary hearings will be closed unless the Board orders that they be public, for good cause, and with the consent of the parties.

Sanctions can be imposed by the Board of a firm if it fails to reasonably supervise any associated person with regard to auditing or quality control standards, or otherwise.

No sanctions report will be made available to the public unless and until stays pending appeal have been lifted.

Section 106: Foreign Public Accounting Firms.

The bill would subject foreign accounting firms who audit a U.S. company to registrations with the Board. This would include foreign firms that perform some audit work, such as in a foreign subsidiary of a U.S. company, that is relied on by the primary auditor.

Section 107(a): Commission Oversight Of The Board; General Oversight Responsibility.

Section 107(b): Rules Of The Board.

Section 107(d): Censure Of The Board And Other Sanctions.

The SEC shall have "oversight and enforcement authority over the Board." The SEC can, by rule or order, give the Board additional responsibilities. The SEC may require the Board to keep certain records, and it has the power to inspect the Board itself, in the same manner as it can with regard to SROs such as the NASD.

The Board, in its rulemaking process, is to be treated "as if the Board were a 'registered securities association'"-that is, a self-regulatory organization. The Board is required to file proposed rules and proposed rule changes with the SEC. The SEC may approve, reject, or amend such rules.

The Board must notify the SEC of pending investigations involving potential violations of the securities laws, and coordinate its investigation with the SEC Division of Enforcement as necessary to protect an ongoing SEC investigation.

The SEC may, by order, "censure or impose limitations upon the activities, functions, and operations of the Board" if it finds that the Board has violated the Act or the securities laws, or if the Board has failed to ensure the compliance of accounting firms with applicable rules without reasonable justification.

Section 107(c): Commission Review Of Disciplinary Action Taken By The Board.

The Board must notify the SEC when it imposes "any final sanction" on any accounting firm or associated person. The Board's findings and sanctions are subject to review by the SEC.

The SEC may enhance, modify, cancel, reduce, or require remission of such sanction.

Section 108: Accounting Standards.

The SEC is authorized to "recognize, as 'generally accepted'... any accounting principles" that are established by a standard-setting body that meets the bill's criteria, which include requirements that the body:
(1) be a private entity;
(2) be governed by a board of trustees (or equivalent body), the majority of whom are not or have not been associated persons with a public accounting firm for the past 2 years;
(3) be funded in a manner similar to the Board;
(4) have adopted procedures to ensure prompt consideration of changes to accounting principles by a majority vote;
(5) consider, when adopting standards, the need to keep them current and the extent to which international convergence of standards is necessary or appropriate.

Section 201: Services Outside The Scope Of Practice Of Auditors; Prohibited Activities.

It shall be "unlawful" for a registered public accounting firm to provide any non-audit service to an issuer contemporaneously with the audit, including: (1) bookkeeping or other services related to the accounting records or financial statements of the audit client; (2) financial information systems design and implementation; (3) appraisal or valuation services, fairness opinions, or contribution-in-kind reports; (4) actuarial services; (5) internal audit outsourcing services; (6) management functions or human resources; (7) broker or dealer, investment adviser, or investment banking services; (8) legal services and expert services unrelated to the audit; (9) any other service that the Board determines, by regulation, is impermissible. The Board may, on a case-by-case basis, exempt from these prohibitions any person, issuer, public accounting firm, or transaction, subject to review by the Commission.

It will not be unlawful to provide other non-audit services if they are pre-approved by the audit committee in the following manner. The bill allows an accounting firm to "engage in any non-audit service, including tax services," that is not listed above, only if the activity is pre-approved by the audit committee of the issuer. The audit committee will disclose to investors in periodic reports its decision to pre-approve non-audit services. Statutory insurance company regulatory audits are treated as an audit service, and thus do not require pre-approval.

The pre-approval requirement is waived with respect to the provision of non-audit services for an issuer if the aggregate amount of all such non-audit services provided to the issuer constitutes less than 5 % of the total amount of revenues paid by the issuer to its auditor (calculated on the basis of revenues paid by the issuer during the fiscal year when the non-audit services are performed), such services were not recognized by the issuer at the time of the engagement to be non-audit services; and such services are promptly brought to the attention of the audit committee and approved prior to completion of the audit.

The authority to pre-approve services can be delegated to 1 or more members of the audit committee, but any decision by the delegate must be presented to the full audit committee.

Section 203: Audit Partner Rotation.

The lead audit or coordinating partner and the reviewing partner must rotate off of the audit every 5 years.

Section 204: Auditor Reports to Audit Committees.

The accounting firm must report to the audit committee all "critical accounting policies and practices to be usedall alternative treatments of financial information within [GAAP] that have been discussed with managementramifications of the use of such alternative disclosures and treatments, and the treatment preferred" by the firm.

Section 206: Conflicts of Interest.

The CEO, Controller, CFO, Chief Accounting Officer or person in an equivalent position cannot have been employed by the company's audit firm during the 1-year period preceding the audit.

Section 207: Study of Mandatory Rotation of Registered Public Accountants.

The GAO will do a study on the potential effects of requiring the mandatory rotation of audit firms.

Section 209: Consideration by Appropriate State Regulatory Authorities.

State regulators are directed to make an independent determination as to whether the Boards standards shall be applied to small and mid-size non-registered accounting firms.

Section 301: Public Company Audit Committees.

Each member of the audit committee shall be a member of the board of directors of the issuer, and shall otherwise be independent.

"Independent" is defined as not receiving, other than for service on the board, any consulting, advisory, or other compensatory fee from the issuer, and as not being an affiliated person of the issuer, or any subsidiary thereof.

The SEC may make exemptions for certain individuals on a case-by-case basis.

The audit committee of an issuer shall be directly responsible for the appointment, compensation, and oversight of the work of any registered public accounting firm employed by that issuer.

The audit committee shall establish procedures for the "receipt, retention, and treatment of complaints" received by the issuer regarding accounting, internal controls, and auditing.

Each audit committee shall have the authority to engage independent counsel or other advisors, as it determines necessary to carry out its duties.

Each issuer shall provide appropriate funding to the audit committee.

Section 302: Corporate Responsibility For Financial Reports.

The CEO and CFO of each issuer shall prepare a statement to accompany the audit report to certify the "appropriateness of the financial statements and disclosures contained in the periodic report, and that those financial statements and disclosures fairly present, in all material respects, the operations and financial condition of the issuer." A violation of this section must be knowing and intentional to give rise to liability.

Section 303: Improper Influence on Conduct of Audits

It shall be unlawful for any officer or director of an issuer to take any action to fraudulently influence, coerce, manipulate, or mislead any auditor engaged in the performance of an audit for the purpose of rendering the financial statements materially misleading.

Section 304: Forfeiture Of Certain Bonuses And Profits.

Section 305: Officer And Director Bars And Penalties; Equitable Relief.

If an issuer is required to prepare a restatement due to "material noncompliance" with financial reporting requirements, the chief executive officer and the chief financial officer shall "reimburse the issuer for any bonus or other incentive-based or equity-based compensation received" during the twelve months following the issuance or filing of the non-compliant document and "any profits realized from the sale of securities of the issuer" during that period.

In any action brought by the SEC for violation of the securities laws, federal courts are authorized to "grant any equitable relief that may be appropriate or necessary for the benefit of investors."

Section 305: Officer And Director Bars And Penalties.

The SEC may issue an order to prohibit, conditionally or unconditionally, permanently or temporarily, any person who has violated section 10(b) of the 1934 Act from acting as an officer or director of an issuer if the SEC has found that such person's conduct "demonstrates unfitness" to serve as an officer or director of any such issuer.

Section 306: Insider Trades During Pension Fund Black-Out Periods Prohibited.

Prohibits the purchase or sale of stock by officers and directors and other insiders during blackout periods. Any profits resulting from sales in violation of this section "shall inure to and be recoverable by the issuer." If the issuer fails to bring suit or prosecute diligently, a suit to recover such profit may be instituted by "the owner of any security of the issuer."

Section 401(a): Disclosures In Periodic Reports; Disclosures Required.

Each financial report that is required to be prepared in accordance with GAAP shall "reflect all material correcting adjustments . . . that have been identified by a registered accounting firm . . . ."

"Each annual and quarterly financial report . . . shall disclose all material off-balance sheet transactions" and "other relationships" with "unconsolidated entities" that may have a material current or future effect on the financial condition of the issuer.

The SEC shall issue rules providing that pro forma financial information must be presented so as not to "contain an untrue statement" or omit to state a material fact necessary in order to make the pro forma financial information not misleading.

Section 401 (c): Study and Report on Special Purpose Entities.

SEC shall study off-balance sheet disclosures to determine a) extent of off-balance sheet transactions (including assets, liabilities, leases, losses and the use of special purpose entities); and b) whether generally accepted accounting rules result in financial statements of issuers reflecting the economics of such off-balance sheet transactions to investors in a transparent fashion and make a report containing recommendations to the Congress.

Section 402(a): Prohibition on Personal Loans to Executives.

Generally, it will be unlawful for an issuer to extend credit to any director or executive officer. Consumer credit companies may make home improvement and consumer credit loans and issue credit cards to its directors and executive officers if it is done in the ordinary course of business on the same terms and conditions made to the general public.

Section 403: Disclosures Of Transactions Involving Management And Principal Stockholders.

Directors, officers, and 10% owner must report designated transactions by the end of the second business day following the day on which the transaction was executed.

Section 404: Management Assessment Of Internal Controls.

Requires each annual report of an issuer to contain an "internal control report", which shall:

(1) state the responsibility of management for establishing and maintaining an adequate internal control structure and procedures for financial reporting; and

(2) contain an assessment, as of the end of the issuer's fiscal year, of the effectiveness of the internal control structure and procedures of the issuer for financial reporting.

Each issuer's auditor shall attest to, and report on, the assessment made by the management of the issuer. An attestation made under this section shall be in accordance with standards for attestation engagements issued or adopted by the Board. An attestation engagement shall not be the subject of a separate engagement.

The language in the report of the Committee which accompanies the bill to explain the legislative intent states, "--- the Committee does not intend that the auditor's evaluation be the subject of a separate engagement or the basis for increased charges or fees."

Directs the SEC to require each issuer to disclose whether it has adopted a code of ethics for its senior financial officers and the contents of that code.

Directs the SEC to revise its regulations concerning prompt disclosure on Form 8-K to require immediate disclosure "of any change in, or waiver of," an issuer's code of ethics.

Section 407: Disclosure of Audit Committee Financial Expert.

The SEC shall issue rules to require issuers to disclose whether at least 1 member of its audit committee is a "financial expert."

Section 409: Real Time Disclosure.

Issuers must disclose information on material changes in the financial condition or operations of the issuer on a rapid and current basis.

Section 501: Treatment of Securities Analysts by Registered securities Associations.

National Securities Exchanges and registered securities associations must adopt conflict of interest rules for research analysts who recommend equities in research reports.

Section 601: SEC Resources and Authority.

SEC appropriations for 2003 are increased to $776,000,000. $98 million of the funds shall be used to hire an additional 200 employees to provide enhanced oversight of auditors and audit services required by the Federal securities laws.

Section 602(a): Appearance and Practice Before the Commission.

The SEC may censure any person, or temporarily bar or deny any person the right to appear or practice before the SEC if the person does not possess the requisite qualifications to represent others, lacks character or integrity, or has willfully violated Federal securities laws.

Section 602(c): Study and Report.

SEC is to conduct a study of "securities professionals" (public accountants, public accounting firms, investment bankers, investment advisors, brokers, dealers, attorneys) who have been found to have aided and abetted a violation of Federal securities laws.

Section 602(d): Rules of Professional Responsibility for Attorneys.

The SEC shall establish rules setting minimum standards for professional conduct for attorneys practicing before it.

Section 701: GAO Study and Report Regarding Consolidation of Public Accounting Firms.

The GAO shall conduct a study regarding the consolidation of public accounting firms since 1989, including the present and future impact of the consolidation, and the solutions to any problems discovered.

Title VIII: Corporate and Criminal Fraud Accountability Act of 2002.

It is a felony to "knowingly" destroy or create documents to "impede, obstruct or influence" any existing or contemplated federal investigation.

Auditors are required to maintain "all audit or review work papers" for five years.

The statute of limitations on securities fraud claims is extended to the earlier of five years from the fraud, or two years after the fraud was discovered, from three years and one year, respectively.

Employees of issuers and accounting firms are extended "whistleblower protection" that would prohibit the employer from taking certain actions against employees who lawfully disclose private employer information to, among others, parties in a judicial proceeding involving a fraud claim. Whistle blowers are also granted a remedy of special damages and attorney's fees.

A new crime for securities fraud that has penalties of fines and up to 10 years imprisonment.

Title IX: White Collar Crime Penalty Enhancements

Maximum penalty for mail and wire fraud increased from 5 to 10 years.

Creates a crime for tampering with a record or otherwise impeding any official proceeding.

SEC given authority to seek court freeze of extraordinary payments to directors, offices, partners, controlling persons, agents of employees.

US Sentencing Commission to review sentencing guidelines for securities and accounting fraud.

SEC may prohibit anyone convicted of securities fraud from being an officer or director of any publicly traded company.

Financial Statements filed with the SEC must be certified by the CEO and CFO. The certification must state that the financial statements and disclosures fully comply with provisions of the Securities Exchange Act and that they fairly present, in all material respects, the operations and financial condition of the issuer. Maximum penalties for willful and knowing violations of this section are a fine of not more than $500,000 and/or imprisonment of up to 5 years.

Section 1001: Sense of Congress Regarding Corporate Tax Returns

It is the sense of Congress that the Federal income tax return of a corporation should be signed by the chief executive officer of such corporation.

Section 1102: Tampering With a Record or Otherwise Impeding an Official Proceeding

Makes it a crime for any person to corruptly alter, destroy, mutilate, or conceal any document with the intent to impair the object's integrity or availability for use in an official proceeding or to otherwise obstruct, influence or impede any official proceeding is liable for up to 20 years in prison and a fine.

Section 1103: Temporary Freeze Authority

The SEC is authorized to freeze the payment of an extraordinary payment to any director, officer, partner, controlling person, agent, or employee of a company during an investigation of possible violations of securities laws.

Section 1105: SEC Authority to Prohibit Persons from Serving as Officers or Directors

The SEC may prohibit a person from serving as an officer or director of a public company if the person has committed securities fraud.

Appendix B – Sample Purchasing Contract

SUPPLY AGREEMENT

This Supply Agreement made this 11th day of January 2002, by and among ROCK OF AGES CORPORATION, a Delaware corporation with its principal office located at 772 Graniteville Road, Graniteville, Vermont 05654 ("ROCK"); and ADAMS GRANITE CO., INC. a Vermont corporation ("Adams").

RECITALS:

WHEREAS, ROCK and Adams have entered into a Purchase and Sale Agreement dated January 11, 2002 ("Purchase and Sale Agreement") pursuant to which ROCK has agreed to sell, and Adams has agreed to purchase, certain real estate and manufacturing assets known as the Lawson Manufacturing Plant.

WHEREAS, capitalized terms shall have the meanings set forth in the Purchase and Sale Agreement, unless otherwise defined herein;

WHEREAS, Pursuant to the Purchase and Sale Agreement, Adams has agreed to enter into a supply agreement with ROCK upon the terms and conditions set forth therein and herein; and

WHEREAS, accordingly, ROCK and Adams believe it is in their mutual interests for Adams to supply granite memorials and monuments to be manufactured at the Lawson Manufacturing Plant (collectively referred to as "Monuments") at prices agreed in advance, all upon the terms and conditions as hereinafter set forth.

NOW THEREFORE, for good and valuable consideration, the receipt and sufficiency of which are herein acknowledged, the parties agree as follows:

1. Purchase and Supply of Monuments. Adams agrees to supply ROCK and its subsidiaries, affiliates and designees (hereafter in this Agreement, the term "ROCK" shall be deemed to include Rock of Ages Corporation and its subsidiaries, affiliates and designees) with Monuments for a term of seven (7) years (herein the "Term"). ROCK will order Monuments with or without sandblast as determined in its sole discretion. ROCK presently expects that approximately twenty percent (20%) of its annual orders will be sandblast charges.

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2. Price for Monuments and Delivery.

a. The price to be charged by Adams for Monuments during the Term shall be as set forth in Exhibit 2.1. Rock will purchase Monuments on open account by submitting its then current purchase order. Purchase orders may be submitted electronically or in hard copy. Each purchase order shall specify a delivery date for the Monument. Delivery dates shall be set in accordance with the then current average lead times at the ROCK manufacturing plant for the particular type of Monument to be produced. ROCK will provide Adams with a current schedule of lead times, which schedule may be amended from time to time by ROCK to reflect any changes in lead times. In the event of a conflict between the purchase order and this Agreement, this Agreement will prevail. No other terms shall be applicable to the purchase of such memorials, including, but not limited to Adam's standard sales or invoice terms. Adams will invoice ROCK

on the first day of each calendar month during the Term for all Monuments shipped during the previous month, which invoice shall be payable within fifteen (15) days from invoice date on a net basis. ROCK shall use its best efforts to place orders with Adams as such orders are received by ROCK from its customers, taking account of customary seasonal patterns in the supply of Monuments.

b. ROCK and Adams each agree that it should be the goal of each party to provide the highest level of quality and service in the supply of Monuments. Accordingly, the parties each agrees to cooperate with each other to facilitate increased efficiencies in the manufacture of Monuments, improved quality of Monuments and, where commercially feasible, reduced lead time for the manufacture of Monuments. In furtherance of this goal, Adams agrees to allow representatives of ROCK reasonable periodic access to Adams plant upon prior notice by ROCK for the purpose of assessing order status and quality control. In addition the parties agree to meet annually to review general performance under this agreement and to discuss items of mutual cooperation.

3. Minimum Ordering Obligations. During the Term ROCK shall place orders for at least Three Million Dollars ($3,000,000.00) (the "Minimum Order") of Monuments from Adams in each year of the Term, commencing January 1, 2002. The Minimum Order may vary up or down by up to Ten Percent (10%) in the first year of this Agreement, and Fifteen Percent (15%) per year thereafter, provided, however, that the aggregate Minimum Order in each Two (2) year period shall equal, as nearly as possible, Six Million Dollars ($6,000,000.00).

EXAMPLE:By way of illustration only, ROCK places orders for $2.7 million in Monuments from Adams for the year ending December 31, 2002, and $3.3 million in Monuments for the year ending December 31, 2003. ROCK has met its Minimum Order requirement for each year over the first two years of the Term.

For the purposes of measuring ROCK's compliance with the Minimum Order requirement, the first two year period shall commence on January 1, 2002 and end on December 31, 2003; the second 2 year period shall commence on January 1, 2004 and end on December 31, 2005; the third 2 year period shall commence January 1, 2006 and end on December 31, 2007; the seventh and final year of the Term shall end on December 31, 2008. If ROCK's Minimum Order for a 2 year period exceeds $6 million, then Adams shall credit ROCK's Minimum Order for the ensuing 2 year period by the excess amount. The Minimum Order for the ensuing period as adjusted by the credit is sometimes referred to herein as the "adjusted Minimum Order." Adams shall credit ROCK's Minimum Order for the seventh and last year of the Term by the amount by which the orders placed by ROCK for the fifth and sixth years of the Term exceed the adjusted Minimum Order for that period.

EXAMPLE: By way of illustration only, assume that the adjusted Minimum Order for the 2 year period ending December 31, 2007 is $5.9 million. ROCK places orders for $3.2 million of Monuments in the year ending December 31, 2006 and $3.4 million of Monuments in the year ending December 31, 2007, for a total of $6.6 million in orders. ROCK's Minimum Order for the year ending December 31, 2008 would be calculated by subtracting $700,000 (the amount by which the combined orders placed by ROCK exceeded the adjusted Minimum Order of $5.9 million for the 2 year period ending December 31, 2007) from $3 million. The Minimum Order for the seventh and last year of the Term would thus be $2.3 million.

During the first year of this Supply Agreement, Adams shall credit ROCK's Minimum Order for 2002 by the amount of the orders and work-in-process assumed by Adams pursuant to the Purchase and Sale Agreement. The Minimum Order in each year of this Agreement may be increased or decreased on January 1 of each year during the term based upon any increase or decrease in the prices that Adams charges to

ROCK for Monuments. Any such increase or decrease in the Minimum Order shall be proportionate to the increase or decrease in prices.

4. Failure to Meet Minimum Order; Remedy. Adams shall provide ROCK with a report of the orders placed by ROCK under this Agreement within Thirty (30) days of the end of each 2 year period, and a report of its orders placed for the seventh year of the Term. ROCK shall verify Adam's report with its own numbers and communicate any discrepancies to Adams. If the orders over such 2 year periods (or, in the case of the seventh year, the 1 year period) are less than the adjusted Minimum Order, then ROCK shall, at its sole option: (i) place orders for Monuments in the amount of the deficiency; or (ii) pay to Adams the gross margin that Adams would have realized had such orders been placed and filled. For the purposes of this Section 3, the gross margin shall be Adams' average gross margin on sales of Monuments to ROCK over the prior 2 year period, calculated in accordance with generally accepted accounting principles, consistently applied. Adams shall keep adequate books and records sufficient to allow ROCK to calculate the average gross margin, and shall allow ROCK access to such books and records in accordance with Section 8 hereof.

EXAMPLE: By way of illustration only, assume that ROCK's Minimum Order for the 2 year period ending December 31, 2003 is $6 million. ROCK purchases $5.7 million of Monuments for the 2 year period ending December 31, 2003, leaving of deficiency in the Minimum Order obligation of $300,000. Assume that Adams' average gross margin for the 2 year period at 20%. ROCK may, at its option: (i) place orders for up to $300,000 of Monuments, which amount shall be credited to the Minimum Order for the 2 year period ending December 31, 2003; pay $60,000 to Adams ($300,000 x 20%); or, a combination of the above two options.

The placement of orders and/or the payment of Adams' estimated gross margin, as provided in section 4(i) or (ii) above, shall be Adam's sole and exclusive remedy for ROCK's failure to meet the Minimum Order. In no event shall ROCK be liable to Adams for any claims or demands in equity for specific performance or claims or demands at law for any further amounts or damages of any kind, whether direct or indirect, including, but not limited to, loss of revenue or profits or any special, incidental or consequential damages, even if ROCK has been advised of the possibility of such damages

5. Warranty. Adams hereby represents and warrants that each Monument supplied under this Agreement shall be fabricated from the memorial grade granite specified in the applicable purchase order, shall conform in all material respects to ROCK's specifications of quality and workmanship, and shall be merchantable and free from defects in material and workmanship. Adams hereby further represents and warrants to, and agrees with, ROCK that none of the Monuments to be supplied by Adams to ROCK under this Agreement will be treated with any artificial materials or liquids and the finished Monuments are the result of standard accepted polishing methods.

6. Defective Memorials. In the event that a Monument sold by Adams to ROCK is flawed, does not conform to the above warranty or is otherwise defective in any respect, Adams shall replace the defective Monument as soon as reasonably possible, it being understood that Adams will use its best efforts to make such replacement as quickly as possible. ROCK shall make any such claim to Adams in writing, identifying the Monument in question and the nature of the flaw, defect or warranty breach. Adams shall respond to each such notice within five (5) days of receipt thereof, and shall provide an estimated time for replacement. If Adams objects to the claim, it shall provide written notice of its objection within the five (5) day period. The parties shall negotiate in good faith to resolve the dispute. If the parties fail to reach agreement within thirty (30) days of notice of claim by ROCK, then the dispute resolution provisions in Section 12.c below shall apply.

7. Default; Remedies

a. Default. The occurrence of any one or more of the events with respect to Adams shall constitute and event of default hereunder ("Event of Default"):

(i) If Adams defaults in its performance of its obligations to ROCK under this Supply Agreement. For the purposes of this Agreement, a default shall include, but not be limited to, repeated and persistent warranty breaches or quality issues in the manufacture and supply of Monuments or repeated and persistent failure to meet the delivery date(s) specified in the applicable purchase orders; or Adams' failure to honor its warranty obligations to Rock.

(ii) If, pursuant to or within the meaning of the United States Bankruptcy Code or any other federal or state law relating to insolvency or relief of debtors (a "Bankruptcy Law") Adams shall: (a) commence a voluntary case or proceeding; (b) consent to the entry of an order for relief against it in an involuntary case; (c) consent to the appointment of a trustee, receiver, assignee, liquidator or similar official; (d) make an assignment for the benefit of creditors; or (e) admit in writing its inability to pay its debts as they become due.

(iii) If a court of competent jurisdiction enters an order or decree under any Bankruptcy Law that (a) is for relief against Adams in an involuntary case; (b) appoints a trustee, receiver, assignee, liquidator or similar official for either Adams or substantially all of its properties; or (c) orders the liquidation of Adams, and the order or decree is not dismissed within 90 days.

b. Remedies. Upon the occurrence of an Event of Default under this Supply Agreement, ROCK shall give Adams written notice of the nature of such Event of Default. ROCK shall have such remedies as are provided for under applicable law and in this Supply Agreement, including, but not limited to, the right to terminate this Agreement.

8. Audit Rights. Each party shall have the right, upon reasonable notice to the other, to review the books and records of the other party to ensure its compliance with the terms of this Supply Agreement.

9. Mutual Customer Base. Each party acknowledges that they now service and may in the future service some of the same customers with granite memorial products. In particular, Adams has done a limited amount of business with certain ROCK authorized retailers and ROCK acknowledges that Adams will continue to do so in the future. Adams agrees and acknowledges that it is ROCK's goal to maintain and increase sales of Monuments to its authorized retailer base and that ROCK will encourage its authorized retailers to buy an increasing percentage of Monuments from ROCK. Adams acknowledges that the maintenance and enlargement of ROCK's business with its authorized retailers, and other retailers who are willing to commit to ROCK's authorized retailer program, is critical to ROCK's success and is critical to ROCK's ability to meet the Minimum Order. Accordingly, Adams will not solicit business from Rock of Ages retailers, and the parties each agree that while they may be in competition with one another from time to time, that they will deal with one another on the basis of trust, good faith and fair dealing, taking account of ROCK's stated goals above.

10. No Solicitation of Employees. For a period of six (6) months after the effective date of this agreement each party agrees not to, directly or indirectly, solicit or induce any employee of the other party to leave that party's employment for any reason whatsoever or to hire any of such party's employees.

11. Non-Disclosure of Confidential Information. Each party acknowledges that they will obtain access to confidential and proprietary information relating to their respective businesses which may or may not be trade secrets, but which is important to the way that the party does business. Each party understands, agrees and covenants that such information is valuable and is intended to be used by such party only in the performance of their respective duties under this Supply Agreement. Therefore, each party covenants and agrees that they will not use, disclose, communicate or divulge such information to any third person or use such information except as may be necessary to perform their respective duties hereunder. Each party's obligations in this section shall survive the expiration or termination of the this Supply Agreement and shall apply as long as any such confidential and proprietary information is not in the public domain.

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12. Miscellaneous

a. This Supply Agreement, together with the Purchase and Sale Agreement, including all exhibits thereto, contains the entire agreement among the parties with respect to the subject matter hereof and thereof. This Supply Agreement may only be amended in writing, signed by all of the parties hereto.

b. Any notice required or permitted to be given hereunder shall be given in accordance with Section 9.7 of the Purchase and Sale Agreement.

c. This Supply Agreement will be governed by the substantive and procedural laws of the State of Vermont without regard to conflicts of laws principles. Any disputes, controversy or claim arising out of or relating to this Agreement, or the breach thereof, shall be settled by arbitration administered by the American Arbitration Association in accordance with its Commercial Arbitration Rules and judgment on the award may be entered in any court having jurisdiction thereof. The arbitration shall take place in the City of Barre, Vermont.

d. This Supply Agreement shall be binding on each party's successors and assigns. This Supply Agreement shall not be assigned by any party hereto without the express prior written consent of the other party. Adams shall not subcontract any of the work to be performed hereunder without the written consent of ROCK, which consent shall not be unreasonably withheld.

e. Subject to section 12.d above, this agreement shall be binding upon and inure solely to the benefit of each party and to the party's permitted successors and assigns; and nothing in this agreement, express or implied, is intended to or shall confer upon any other person an right, benefit or remedy of any nature whatsoever under or by reason of this agreement.

f. The headings of Sections in this Supply Agreement are provided for convenience only and will not affect its construction or interpretation. All references to "Section" or "Sections" refer to the corresponding Section or Sections of this Supply Agreement unless otherwise specified.

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g. Neither party will be deemed in default of this Agreement to the extent that performance of its obligations, or attempts to cure any breach, are delayed or prevented by reason of any act of God, accidents, labor disputes, military conflicts, insurrections, riots, explosions, lightning, earthquake, fires, storms, floods or other cause outside of the party's reasonable control or other force majeure; provided that, such party promptly gives written notice of the condition and undertakes commercially reasonable efforts

to circumvent the effects of such force majeure. In any such event, the time for performance will be extended for a period equal to the duration of any delay occasioned by the force majeure, provided, however, that such extension period shall not exceed four (4) weeks.

h. Each Exhibit delivered pursuant to the terms of this agreement shall be in writing and shall constitute a part of this agreement. The parties may agree with respect to any Exhibit required to be attached to this agreement, that such Exhibit, if mutually satisfactory, may be attached to this agreement after the date of execution hereof and after mutual approval thereof, such subsequently attached Exhibit shall be treated as if it were attached to this agreement as of the date of execution of this agreement. All Exhibits attached hereto are specifically incorporated herein by reference and made a part hereof. The words "agreement," "herein" and "hereof" as used herein shall in all respects include the entirety of this agreement together with all Exhibits attached hereto and all documents required or permitted to be delivered hereunder.

IN WITNESS WHEREOF, the parties hereto have executed this agreement all as of the date first above written.

WITNESS ROCK OF AGES CORPORATION

By: _____
Kurt M. Swenson, Chairman/CEO

WITNESS ADAMS GRANITE COMPANY, INC.

By: _____
Kerry F. Zorzi, President

EXHIBIT 2.1
TO
SUPPLY AGREEMENT
Between
ADAMS GRANITE CO., INC.
and
ROCK OF AGES CORPORATION

Pricing

Until December 31, 2002

Prices shall be 43.35% below those listed in the 2001 Adams Granite Co. price book (attached to this Exhibit 2.1) for the monuments shown therein, provided, however, that prices for sandblast shall be 49% below those listed in the Adams Granite Co. price book.

After December 31, 2002

Beginning January 1, 2003 and on each successive January 1 during the term thereafter, Adams may increase its prices from those set in the previous year by an amount equivalent to the increase in Adams's production costs during the prior year, provided, however, that the prices charged hereunder shall remain competitive with the prevailing prices for monuments and sandblast from other manufacturers in the Barre,

Vermont area; and provided further that any annual price increase shall not be made more than once annually and shall be capped at Five Percent (5%). Such price increases shall be communicated in writing by Adams to ROCK and shall be effective thirty (30) days from the date that such communication is received by ROCK. Any notice of price increase shall include a breakdown of the increased production costs showing how the new prices were calculated. ROCK shall have full access to Adams's books and records to verify such price increases, and shall have thirty (30) days in which to object to such price increases. If ROCK objects to the price increases, the parties shall negotiate in good faith to reach agreement on the revised pricing. If the parties fail to reach agreement within thirty (30) days of notice of such objection by ROCK, then the dispute resolution provisions in Section 9.c of the Agreement shall apply. During any such dispute, Adams shall continue to supply Monuments to ROCK under the new pricing schedule, provided, however, that the difference between the old and new prices shall be deposited by ROCK into an escrow account pending resolution of the dispute.

For the purposes of this Agreement, production costs shall be limited to:

Direct labor
Indirect labor
Benefits
Power and fuel
Supplies
Materials
Property taxes on Plant and Improvements
Property and Casualty Insurance