To: Financial Manager **Top Tier Parts Company**	**From:** The Modal Shop, Inc. Scott Sorensen, Operations Manager Bill Pohl, Sales Manager Gail Stultz, NDT Product Group Manager
Date: June 30, 2004	**Document Number:** Composite BC 093003 Condensed

TMS Resonant Acoustic Method (RAM) NDT-SEMI System: Return on Investment Study

ABS Control Bracket Production Line

Top Tier Parts Co.

Peoria, IL Plant

Executive Summary

Automotive manufacturers are currently pulling double duty on parts suppliers. On the one hand, they expect zero defects and 100% parts inspection prior to shipment and are increasingly contractually requiring it, effectively pushing the cost of inspection down to the supplier. On the other hand, they want lower costs on parts. It is imperative for parts suppliers to find tools to help them maintain high quality while keeping costs low. The combination of high quality/low cost parts will result in increased sales and profits to automotive parts suppliers.

This business case looks at detecting quality problems with the powdered metal ABS Control Bracket produced at Top Tier Parts Co.'s Peoria, IL facility for B3 Auto using The Modal Shop's RAM NDT-SEMI system as an end-of-line test station.

The financial justification presented here derives from Top Tier's stated business objective for investing in NDT technology of cost avoidance associated with shipping bad parts. Using conservative cost data for potential recall costs and savings resulting from process improvements, the following net cash flow impact, IRR and ROI was determined. As can be seen from the figures in the tables, even when recall costs are excluded from the analysis, the system's process improvement benefits alone allow for a substantial 5-year ROI and 13-month payback period. When recall costs are included, the ROI and IRR escalate substantially and the payback period is less than 1 year.

Base Scenario

Estimated net benefit (cost) over the evaluation period:

	$ in 1000s
Net Incremental Cash Flow	**$1,107.3**
Simple Return on Investment (ROI)	**2922%**
Internal Rate of Return (IRR)	**852%**
Payback Period (in Years)	**<1**
Cash Flow Discounted at 9.0%	$888.4
Cash Flow Discounted at 15.0%	$779.4
Analysis Period Start Date:	1-Oct-03
Analysis Period End Date:	30-Sep-08
Evaluation period length:	60 Months

Major Assumptions: $400,000 recall, $14,000 sorting, process improvements, labor savings, no contract loss, no new business hold

Sensitivity Scenario 1

Estimated net benefit (cost) over the evaluation period:

	$ in 1000s
Net Incremental Cash Flow	**$181.7**
Simple Return on Investment (ROI)	**479%**
Internal Rate of Return (IRR)	**103%**
Payback Period	**1.1**
Cash Flow Discounted at 9.0%	$131.0
Cash Flow Discounted at 15.0%	$106.6
Analysis Period Start Date:	1-Oct-03
Analysis Period End Date:	30-Sep-08
Evaluation period length:	60 Months

Major Assumptions: $0 recall, $14,000 sorting, 1/2 process improvements of base scenario, no labor savings, no contract loss, no new business hold

The system's process monitoring capabilities are enough to financially justify the RAM NDT-SEMI system, the added benefit of insuring against recall and other quality related costs imposed by customers makes the financial decision to invest in the technology clear.

Before the financial justification can be relevant, the RAM NDT-SEMI system's technical ability to reliably and quickly inspect for quality problems must be established. Top Tier's engineers have identified the system as being technically feasible and time efficient in testing for inherent quality problems on the ABS Control Bracket.

A number of non-financially quantified benefits of shipping good parts are identified in the report and are important considerations when weighing the decision to implement an NDT test system for end-of-line part quality testing. These benefits have long term financial impacts on Top Tier and include: improved corporate image related to being known as a supplier of consistently good quality parts, competitive advantages related to high quality/low cost production ability, manufacturing process monitoring which helps keep the manufacturing process running as efficiently as possible thereby reducing overall production costs, marketing and sales benefits by being able to highlight quality achievements and recognition awards related to good quality parts, and cost savings or process improvement information that can be shared with other Top Tier facilities or parts lines as a result of using the system.

The system's high ROI and low cost of ownership per part make it ideally suited for accomplishing the business objectives of zero defects and low cost necessary to maintain competitive advantage and profitability in the highly competitive powdered metal automotive parts market.

Table of Contents

A. Introduction

The business generated by B3 Auto Corp. for Top Tier is significant and encompasses the ABS Control Bracket discussed here as well as numerous other powdered metal parts for everything from suspension parts to transmission gears. Top Tier would like to expand their customer base further to other automotive manufacturers and continuing to be known as a low cost supplier of quality parts is critical to their success. Quality problems will severely hamper Top Tier's expansion plans.

1. Business Case Subject

This case examines the likely benefits and costs of investing in The Modal Shop's semi-automated Resonant Acoustic Method non-destructive test system (RAM NDT-SEMI) as part of an end of line quality test station for the ABS Control Bracket line at Top Tier Parts Co.'s Peoria, IL plant. The system is integrated into the existing production process and is meant to allow for 100% end of line parts inspection and solve the potential problem of shipping parts with missing or misaligned caliper bores, damaged, oxidized, cracked, or otherwise unusable key ways or main body flaws. It is also a replacement for the previous methods of eddy current and visual inspection that were utilized to inspect these parts prior to shipment.

The proposed NDT system is necessary to meet the customer's requirement for **zero defects** and **100% parts inspection** prior to shipment to prevent non-usable parts from being shipped to its manufacturing facilities.

2. Business Case Purpose

The purpose of this case is to examine in detail the **financial ramifications** to Top Tier of adding TMS' RAM NDT-SEMI system as an end-of-line inspection station. The results will be used by Top Tier as an additional financial information source on the costs and benefits of utilizing an NDT test system on a powdered metal part and possibly as a framework for the justification of future systems for other powdered metal products.

This particular case examines a TMS RAM NDT-SEMI system proposed for the ABS Control Bracket line by Top Tier and explores the costs and benefits that Top Tier can expect from the system as well as what goals, both financial and non-financial, that can be expected by the addition of the system.

3. Background

The ABS Control Bracket is manufactured from powdered metal and is a relatively complex geometry. After the part is sintered there are secondary operations performed that include drilling and tapping three mounting locations, machining a keyway in the side of the part and spot facing the top and bottom.

Historically, a combination of inspections via an eddy current system and visual inspection has been the NDT inspection methods of choice for examining ABS Control Bracket quality after machining and prior to shipment. However, with the automotive manufacturers increased emphasis on quality due primarily to market pressures demanding ever higher quality and durability in the end product and the heavy financial and image costs related to product recalls, part quality assurance has been pushed down and emphasized, increasingly contractually, on parts suppliers like Top Tier.

Eddy current systems are excellent at finding surface flaws in a known location on a part, but can miss internal cracks or voids and surface flaws in areas on the part that aren't being directly inspected. Subjective visual inspection also will miss the non-obvious flaws in the bad parts. The TMS RAM NDT-SEMI system is an **objective whole part inspection system** designed to find internal as well as external cracks, voids, geometry flaws, process related inconsistencies that manifest themselves in part density shifts, out of specification hardness or improper coining or sintering.

a. Connections to other Projects/Products or Programs

As a result of the experience of using TMS' RAM NDT-SEMI system at the Peoria, IL plant, this method of non-destructive testing can be utilized effectively on other types of powdered metal parts and on future production lines installed to handle additional manufactured part quantities as Top Tier grows its sales and increases the number of powdered metal parts supplied to the automotive manufacturers.

Also, since the testing process is objective, reliable and repeatable, any variations in subsequent scrap rates of parts being tested on the RAM NDT-SEMI system can signal problems upstream in the manufacturing process that might otherwise go unnoticed for a longer period of time. Catching these process variations early can result in **increased manufacturing asset utilization** and ultimately lower per piece costs.

b. Other, Alternative Actions

Alternatives to adding TMS' RAM NDT-SEMI system include continuing to utilize eddy current and visual inspection, outsourcing NDT testing to an independent vendor, doing no inspection or utilizing a different NDT technique to catch part flaws.

However, visual inspection is not 100% reliable and is subjective, varying by individual. In *Juran's Quality Handbook*, Juran states that visual inspectors average only 80% reliability – this statistic is a reflection of the human interpretation factor, not the accuracy of the techniques themselves, see ref 1. Doing no part quality inspection carries financial risks that are excessive, outsourcing to an independent NDT contractor is time consuming, increases per part costs, and is outside Top Tier's direct control, and eddy current testing for this part's typical flaws has proven less reliable than TMS' RAM NDT-SEMI system.

c. Other Important Historical or Situational Information

Top Tier Parts Co. has been issued a Quality Reject and Recall orders (QRR) for this part in the past that has resulted in expensive on-site sorting of parts at B3 Auto Corp., increased inspections at the Top Tier facility and threatened contract cancellation and new business hold if quality issues are not addressed proactively. Additionally, Top Tier was issued a recall order for a similar part for another manufacturer that resulted in a $400,000 charge to Top Tier in shared recall costs including remanufacturing and re-inspection costs totaling $80,000. Top Tier manufactures many powdered metal parts for B3 Auto Corp. and is strongly financially motivated to avoid quality issues that would jeopardize their standing as a preferred parts supplier to B3 Auto.

4. Disclaimer

The information contained herein was gathered from a multitude of sources and is based on years of experience in the non-destructive testing market. Every effort has been made to be conservative and realistic on both the costs and benefits side of the case and the assumptions used are spelled out in the Assumptions and Methods section. While this case is based on actual circumstances, all information contained herein is fictitious and likeness to a specific company is purely coincidental.

B. Methods and Assumptions

1. Financial Metrics

For this case examining the financial impact of TMS' RAM NDT-SEMI on the ABS Control Bracket at Top Tier' Peoria IL facility will be measured using net cash flow, return on investment (ROI), payback period and internal rate of return (IRR). Payback period is an especially useful to gauge the risk of an investment. The shorter the payback period, the lower the risk.

2. Business Case Scope and Boundaries

As mentioned previously, this business case examines the powdered metal ABS Control Bracket part manufactured at the Top Tier Peoria, IL facility and inspected by The Modal Shop's RAM NDT-SEMI system. The costs and benefits included in this case apply solely to the Top Tier Peoria facility although the thought process and results can be applied to other parts on other lines within the Top Tier network of production facilities.

3. Scenario Design

The main business objective put forth for considering a semi-automated inspection system was cost avoidance or cost savings. The only way to identify cost savings for the business case is to compare cost estimates from different scenarios.

Two separate scenarios are examined in this case. The difference between 'business with TMS' RAM NDT-SEMI' and 'business as usual' is explored. For the 'business as usual' case it is assumed that eddy current and visual inspections are continued to catch the majority of flaws in the part. As the name suggests, the 'business with TMS' RAM NDT-SEMI' part quality is inspected using the RAM NDT-SEMI system.

4. The Cost Model

The costs included in this case are limited to the actual incremental costs associated in the two scenarios. Only costs that can be directly associated with the acquisition and use of the RAM NDT-SEMI system are relevant and include the following:

<u>Cost Items</u>

- Cost of acquisition of the TMS RAM NDT-SEMI system including training and initial set-up. List price of $29,900 is used in the analysis.
- Cost of RAM NDT-SEMI system service contract that covers system components with overnight replacement and includes all software upgrades. List price of $4,995 annually is used throughout the analysis.
- Cost to sound isolate the RAM NDT-SEMI system. Acoustic tunnel NDT-AC1, list price of $2,000 is used.

- Cost to integrate the RAM NDT-SEMI system into the existing production conveyor system. Cost estimated by Top Tier to be $1,000 consisting of 16 hours of labor at overtime rates, some small brackets to attach the RAM NDT-SEMI system and acoustic tunnel, and photo eyes for part recognition and triggering. Retrofitting of production line including necessary PLC programming will occur after second shift so no production interruption is needed.

Cost Avoidance Items

- Cost of part recall. For the base scenario, $400,000 is used as the recall cost since that amount was the result of a recall order issued previously for a similar part. In the sensitivity section, recall costs of $0 is used.
- Cost of additional part sorting. Estimated cost of $14,000. $1,000 per part bin (approx 2500 parts per bin) at customer's site with 5 days or 14 bins worth of inventory on-site to sort utilizing Top Tier employees.
- Labor costs. The addition of the RAM NDT-SEMI system will result in the ability to reallocate two production personnel currently responsible for visual inspection to other lines within the facility. By being able to reassign existing employees, Top Tier can avoid the time and expense necessary to hire two new employees that would have otherwise been added. Labor cost savings (including labor overhead) to Top Tier are $63,000 per year. No labor savings is used in the Sensitivity Analysis Section.

5. The Benefits Rationale

This section establishes the legitimacy of benefits beyond cost savings. Although cost avoidance is the primary benefit being examined in this case, there are other business objectives that can be aided by the addition of the NDT system related to part quality and process improvements.

Taking action to improve part quality shipped (the impact) may be established as a business case benefit by establishing:

- Business objective: **improving part quality shipped**
  - Important because it avoids costs associated with shipping poor quality parts
  - tangible measure: **100% parts inspection** by reliable objective means
  - tangible result: No quality reject and recall orders from customers for part flaws
  - target for the *objective:* **zero defects**
  - target for the *benefit impact:* having no recall orders and maintaining current parts contracts
  - value of reaching the objective's target:
    avoid recall and sorting costs that can be extremely expensive

Other benefits of using the system are **operational efficiencies** that are discovered when scrap rates increase from historic levels allowing the manufacturing process to be examined for changes in process or material and tweaked to reduce variations that cause quality problems.

- Business objective: **improving manufacturing process**

- Important because it **reduces manufacturing costs** by making the manufacturing process more efficient
- tangible measure: variance in scrap rates
- tangible result: **maximized manufacturing efficiency**
- target for the *objective:* **no process related defects**
- target for the *benefit impact:* reduce historic 3.6% scrap rate to 2.4%
- value of reaching the objective's target: reducing scrap rate from 3.6% to 2.4% will result in a reduction of $93,600 in production costs annually. 28,800 fewer scrapped parts on annual 2,400,000 part run at $3.25 per part manufacturing cost.

- Business objective: **improving efficiency of secondary operations**
  - Important because it reduces overall manufacturing costs by eliminating secondary operations performed on flawed parts
  - tangible measure: **reduced machining costs**
  - tangible result: **extended machine tool life**
  - target for the *objective:* no secondary operations on flawed parts
  - target for the *benefit impact:* reduce tool wear by 1.2%.
  - value of reaching the objective's target: reducing tool wear by 1.2% will result in a reduction of $3,000 in machining costs annually. 28,800 fewer machined parts on annual 2,400,000 part run at $0.1042 per part variable machining cost.

6. Data Structure

For this business case, incremental cash flow data will be presented when comparing the base scenario (business with TMS RAM NDT-SEMI) and (business as usual). The cost and benefit data will be formatted in tables with cost savings or avoidance shown as positive cash inflows and cost items shown as negative cash outflows.

7. Assumptions

These assumptions cover both the 'business with TMS' RAM NDT-SEMI' and 'business as usual' scenarios and the alterations to those scenarios in the Sensitivity and Risk Analysis section.

The overriding assumption is that the combination of eddy current and visual inspection is insufficient to find all of the parts with flaws. There has already been one formal quality related action (B3 Auto issued QRR) resulting in additional sorting and re-inspection costs and receiving a second will result in new business hold until corrective actions have been implemented and approved by B3 Auto.

Quality Related Corrective Actions

The major assumption in this business case is that Top Tier could have been assessed a quality related corrective action in the form of **on-site sorting** ($14,000) and increased in-house inspections. Subsequently, a **recall order** ($400,000) would have been issued and associated costs would be incurred resulting from shipping non-usable ABS Control Brackets to B3 AUTO.

The costs to Top Tier related to a corrective action are based on the assumptions that shipping bad parts utilizing eddy current and visual inspection will result in customer required action to control quality. Further, that shipping bad parts in a zero defect

environment will result in a product recall and the expenses resulting from the recall will be shared by Top Tier.

Technical Feasibility

It has also been proven by Top Tier that from a technical aspect the TMS NDT solution is able to identify the flaws on parts on the complex geometry of the ABS Control Bracket that other methods of non-destructive testing could not identify effectively.

Labor Related

From a labor standpoint it is assumed that the personnel used for eddy current prior to the addition of the RAM NDT-SEMI will be trained as users of the NDT system; therefore their positions will not be eliminated. Also, the personnel previously responsible for visual inspection will be reassigned to other manufacturing lines within Top Tier and allow Top Tier to avoid the time and cost necessary to hire two additional production personnel for the other manufacturing lines. Labor savings equal $63,000 per year. 2 personnel x $12/hour plus 33% labor overhead factor.

Secondary Operations

By utilizing the RAM NDT-SEMI system in-line directly after sintering and identifying and segregating flawed parts immediately then secondary machining operations are avoided on flawed parts saving time and tool wear. Secondary operations savings of $3,000 per year. 28,200 fewer flawed parts machined at $0.1042 cost per part.

Process Improvements

The historical scrap rate for the ABS Control Bracket has been a relatively low 3.6%. The production process was examined and the oven speed and atmosphere adjusted slightly. The process adjustments lowered the scrap rate to the current 2.4%. It is assumed that productivity improvements will keep the overall scrap rate at 2.4% or less for the 5-year analysis period minimum and that the scrap rate would have remained at the historic 3.6% level with the eddy current and visual inspection alone. Process improvements result in annual savings of $93,600. Reduced scrap of 1.2% x 2,400,000 total parts produced annually x $3.25 cost per part.

C. Business Impacts

The following tables and graphs illustrate the business impact of adding TMS' RAM NDT-SEMI as an end of line inspection station for the ABS Control Bracket.

Cash flow is the fundamental financial metric in the business case. Each important cost or benefit impact leads to an expected cash flow result, or is otherwise assigned value in cash flow terms. Other financial metrics in the analysis derive from the summary totals at the bottom of the cash flow statement.

All cash *inflows* are positive numbers (no parenthesis, no minus signs) and all cash *outflows* are negative numbers (with parenthesis or minus sign). That way, all totals and intermediate results within each statement are always obtained by *adding* numbers above them.

1. Financial Model and Cash Flow Statements

a. CASH FLOW SUMMARY

The following table illustrates the incremental cash flow derived from the decision to invest in the TMS RAM NDT-SEMI system.

RAM NDT-SEMI system at SSI	**Incremental Results**			No tax impacts. Cost savings as incremental expenses.			
Base Scenario: RAM NDT-SEMI on ABS Control Bracket Line less Business as Usual (eddy current/visual inspection)							
$ in 1000s	**INCREMENTAL CASH FLOW STATEMENT**						
For the year ending	Year 0 Oct 2003	Year 1 Oct 2004	Year 2 Oct 2005	Year 3 Oct 2006	Year 4 Oct 2007	Year 5 Oct 2008	TOTAL
BENEFITS / GAINS	Initial Investment						
Labor Savings	0.0	63.0	63.0	63.0	63.0	63.0	315.0
Process Improvements	0.0	46.8	93.6	93.6	93.6	93.6	421.2
Secondary Operations Efficiencies	0.0	3.0	3.0	3.0	3.0	3.0	15.0
Total Benefits/Gains	0.0	112.8	159.6	159.6	159.6	159.6	751.2
OPERATING EXPENSE ITEMS							
Cash inflows (outflows)							
Hardware Expenses							
RAM NDT-SEMI System	(29.9)	0.0	0.0	0.0	0.0	0.0	(29.9)
RAM NDT-SEMI Service Contract	(5.0)	(5.0)	(5.0)	(5.0)	(5.0)	0.0	(25.0)
Sound Isolation (NDT-AC1)	(2.0)	0.0	0.0	0.0	0.0	0.0	(2.0)
Installation Expense	(1.0)	0.0	0.0	0.0	0.0	0.0	(1.0)
Quality Related Expenses							
Product Recall	0.0	200.0	200.0	0.0	0.0	0.0	400.0
Additional Parts Sorting	0.0	14.0	0.0	0.0	0.0	0.0	14.0
Contract Cancellation	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New Business Hold	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Impact: Op Exp Items	(37.9)	209.0	195.0	(5.0)	(5.0)	0.0	356.1
CASH FLOW SUMMARY							
Cash inflows (outflows)							
Incremental benefit impacts	0.0	112.8	159.6	159.6	159.6	159.6	751.2
Incremental expense item impacts	(37.9)	209.0	195.0	(5.0)	(5.0)	0.0	356.1
Net Incremental CASH FLOW	**(37.9)**	**321.8**	**354.6**	**154.6**	**154.6**	**159.6**	**1,107.3**
Cumulative Net Incremental CF	(37.9)	283.9	638.5	793.1	947.7	1,107.3	1,107.3
Discounted Incremental Cash Flow							
At 9.0%	(37.9)	295.2	298.5	119.4	109.5	103.7	888.4
At 15.0%	(37.9)	279.8	268.1	101.7	88.4	79.3	779.4

b. Analysis of Results

As can be seen from the table below, the return on investment for the business case for adding TMS' RAM NDT-SEMI is extremely high. The realized cost avoidance as a result of using the system to prevent bad ABS Control Brackets from shipping to B3 AUTO is sufficiently high to make the ROI calculation high as well.

RAM NDT-SEMI system at SSI **Incremental Results** No tax impacts. Cost savings as incremental expenses.

Base Scenario: RAM NDT-SEMI on ABS Control Bracket Line less Business as Usual (eddy current/visual inspection)

For the year ending	Year 0 Oct 2003	Year 1 Oct 2004	Year 2 Oct 2005	Year 3 Oct 2006	Year 4 Oct 2007	Year 5 Oct 2008	TOTAL
Net Incremental CASH FLOW	(37.9)	321.8	354.6	154.6	154.6	159.6	1,107.3
Simple ROI		749%	1685%	2093%	2501%	2922%	2922%
Payback	<1 Year						
IRR	852%						

Payback period is also useful to gauge the risk of an investment. The shorter the payback period is the less risk there is in the investment. The payback period for each scenario presented in this case is less than one year. The only exception is in the scenario that excludes recall costs. With no recall costs, the payback period is 1.1 years or approximately 13 months.

2. Non-financial and Non-quantified results

The business case analysis includes the relevant financial costs and benefits and the inclusion of these additional non-quantified benefits completes the overall picture.

There are some benefits of using TMS' RAM NDT-SEMI system that are difficult to quantify accurately, but the benefits are nonetheless very real. These are enumerated here as non-quantified benefits. Non-quantified benefits are an important part of this business case and they have a definite financial implication.

Competitive advantages can be achieved by reducing the costs associated with poor quality by using systems like RAM NDT-SEMI, thereby allowing per part costs to stay lower than the competition while at the same time maintaining the quality level automotive customers have come to demand. This low cost/high quality combination gives an advantage in obtaining new parts orders.

Process improvements can be discovered through use of the system and monitoring of subsequent scrap rates. If scrap rates suddenly jump or are higher than expected, the RAM NDT-SEMI system can assist engineers in pinpointing the problem and testing process adjustments for effectiveness, which lowers overall production costs.

The system is also a **process monitor** for undocumented process changes, such as increasing the speed of the sintering process that can lead to quality problems. This helps keep undocumented process changes from affecting part quality and subsequent scrap rates tremendously and keeps overall production costs down.

Shared information among Top Tier facilities. Information gathered as a result of using the RAM NDT-SEMI system regarding process improvements, potential part faults, product variations, and other related quality issues can be shared among all of

Top Tier's powdered metal production facilities leading to improved part quality and improved processes throughout Top Tier.

Overall corporate image can be increased by becoming known or maintaining the corporate reputation of supplying only good quality parts to customers via 100% inspection. Being known as the quality supplier can help open doors for the sales process and might be the difference between landing or losing an order.

Along those same lines, the **reputation** of the Peoria facility within Top Tier corporate can be bolstered by improving quality to the point of becoming the gold standard for quality among powdered metal parts plants.

D. Sensitivity and Risk Analysis

This section discusses the sensitivity of the financial data used to the results obtained, the risks associated with adding an NDT system to the manufacturing process and what factors are most important to maximizing the most likely benefits of the system.

Eight different variations of the main scenarios are presented here to illustrate the factors that have the biggest impact on the financial results and to present alternative assumptions for comparison purposes.

Each sensitivity scenarios cash flow table, graph and ROI calculation is presented in the Appendix.

1. Sensitivity Analysis

Scenario 1 no recall, exclude labor savings, ½ process improvement savings

In this sensitivity analysis all assumptions remain the same except recall expense is figured at $0 instead of $400,000, labor savings is figured at $0 instead of $63,000 and process improvement savings are estimated to be $46,800 instead of $93,600.

ROI 5-year = 479% Net Incremental Cumulative Cash Flow 5-year = $181,700
ROI 3-year = 230% Net Incremental Cumulative Cash Flow 3-year = $ 87,500
ROI 1-year = -7% Net Incremental Cumulative Cash Flow 1-year = ($ 2,500)
Payback period = 1.1 years, approximately 13 months.

2. Risk Analysis

Uncertainty about a situation can often indicate ***risk***, which is the possibility of loss, damage, or any other undesirable event. Most organizations desire low risk, which would translate to a high probability of success, profit, or some form of gain.

There are two points to keep in mind when analyzing risk:

1. Where is the risk?
2. How significant is the risk?

For this case, the risk is in shipping bad parts and the result can be expensive reactive quality assurance costs that can include redundant inspections, on-site sorting, product recall, and new business hold.

Once the risks have been identified, a model can help quantify the risks. Quantifying risk means putting a value or price on risk, to help determine whether a risk is worth taking. For example, if there is a 20% chance of shipping bad parts using eddy current and visual inspection, costing Top Tier $10,000, that might be a

risk worth taking. But if there is even a 5% chance of shipping bad parts, knowing that there is a $300,000 penalty, mitigating that risk becomes paramount.

One aspect of risk management within an organization involves identifying preventative measures to avoid a risk or to reduce its effect. This part of the process involves the formulation of management responses to main risks. It may start during the qualitative analysis phase, as the need to respond to some risks may be urgent and the solution fairly obvious. This is the case with the ABS Control Bracket and the RAM NDT-SEMI system. The financial risk of shipping bad parts is real and significant and the solution via 100% parts inspection with the RAM NDT-SEMI system is obvious.

Quality related recalls are expensive propositions, especially when faulty parts make it into automobiles and subsequently need to be recalled to fix or replace the faulty parts. The costs can add up quickly for an expensive component such as ABS braking systems. Automotive companies will not tolerate nor keep doing business with parts suppliers that cannot ensure quality parts delivered to them.

There is a financial cost associated with shipping faulty parts. These costs can originate from recall related expenses ranging from on-site sorting of parts to parts recalls to allocated costs for end product recalls charged by the customer to the parts supplier. Add on top of that the very real possibility that future parts contracts could be adversely affected by current quality problems and the costs quickly multiply. The relatively low cost of TMS' RAM NDT-SEMI system in comparison to the quickly escalating costs related to product quality issues make the financial risks of investing in the system minimal.

E. Conclusions and Recommendations

As can be seen from the analysis, it does not take too many quality related costs to quickly and easily justify the addition of the NDT system as an end of line test station. The potential costs of shipping bad parts so far outweigh the costs of acquiring the RAM NDT-SEMI system that the decision to add it becomes obvious.

Dynamic measurements in the manufacturing process, like those achieved with the use of the RAM NDT-SEMI, puts Top Tier at the forefront of six sigma quality measurement. What gets measured improves. The system allows Top Tier to mitigate risk while aiding in process improvement capability.

1. Conclusions

TMS' RAM NDT-SEMI system allows Top Tier to keep inspection costs low while following the contractual obligation for 100% parts inspection imposed by B3 Auto.

Also, utilizing RAM NDT-SEMI as an end of line test stand has numerous advantages whether the manufacturing line is operating flawlessly or is turning out bad parts.

When the manufacturing process is operating error free, it protects the integrity of the process and exposes variations.

When the process generates a bad part occasionally, it identifies and contains the faulty ones before they get shipped to the customer and cause bigger headaches and costs for everyone.

When the process becomes non-conforming, producing a larger number of bad parts, it acts as a sentry alerting the line personnel there is a problem and can help determine when the process is back in normal operating mode.

2. Recommendations

As can be seen from the large ROI's and low per piece cost of adding TMS' RAM NDT-SEMI system, as long as the system is technically able to determine the part fault being tested for, then investment in the system is a strong business decision with low financial risk. Catch one bad part, that if shipped could lead to recall expense, contract cancellation or increased scrutiny by the customer and the system has easily paid for itself. Compound that with the costs of new business hold on the Peoria facility or on Top Tier's entire network of powdered metal facilities in North America and the acquisition costs of NDT test systems becomes minor in comparison.

Combine the lowered financial risk of being able to positively 100% inspect the ABS Control Bracket for faults with the process improvements and the process monitoring uses for the system and the investment decision becomes even easier.

In the current market environment of automotive customers contractually requiring 100% parts inspection and zero defects becoming the de facto standard to remain competitive in the powdered metal parts market, a financially justified, reliable, repeatable, objective, low cost of ownership, NDT system is a required manufacturing tool.

F. Appendixes and References

1. Appendix

Cash flow tables and ROI calculations for each of the variations detailed in the sensitivity analysis section along with the major assumptions for each.

2. References

[1] Juran, Joseph M. and Godfrey, A. Blanton, Fifth Edition, *Juran's Quality Handbook*, McGraw-Hill.

3. 2-page Business Case overview

Sensitivity Scenario 1: RAM NDT-SEMI on ABS Control Bracket Line less Business as Usual (eddy current/visual inspection)

Sensitivity Scenario 1

Estimated net benefit (cost) over the evaluation period:

	$ in 1000s
Net Incremental Cash Flow	**$181.7**
Simple Return on Investment (ROI)	**479%**
Internal Rate of Return (IRR)	**103%**
Payback Period	**1.1**
Cash Flow Discounted at 9.0%	$131.0
Cash Flow Discounted at 15.0%	$106.6
Analysis Period Start Date:	1-Oct-03
Analysis Period End Date:	30-Sep-08
Evaluation period length:	60 Months

Major Assumptions: $0 recall, $14,000 sorting, 1/2 process improvements of base scenario, no labor savings, no contract loss, no new business hold

RAM NDT-SEMI system at SSI **Incremental Results** No tax impacts. Cost savings as incremental expenses.

Sensitivity Scenario 1: RAM NDT-SEMI on ABS Control Bracket Line less Business as Usual (eddy current/visual inspection)

$ in 1000s **INCREMENTAL CASH FLOW STATEMENT**

For the year ending	Year 0 Oct 2003	Year 1 Oct 2004	Year 2 Oct 2005	Year 3 Oct 2006	Year 4 Oct 2007	Year 5 Oct 2008	TOTAL
BENEFITS / GAINS	Initial Investment						
Labor Savings	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Process Improvements	0.0	23.4	46.8	46.8	46.8	46.8	210.6
Secondary Operations Efficiencies	0.0	3.0	3.0	3.0	3.0	3.0	15.0
Total Benefits/Gains	0.0	26.4	49.8	49.8	49.8	49.8	225.6
OPERATING EXPENSE ITEMS							
Cash inflows (outflows)							
Hardware Expenses							
RAM NDT-SEMI System	(29.9)	0.0	0.0	0.0	0.0	0.0	(29.9)
RAM NDT-SEMI Service Contract	(5.0)	(5.0)	(5.0)	(5.0)	(5.0)	0.0	(25.0)
Sound Isolation (NDT-AC1)	(2.0)	0.0	0.0	0.0	0.0	0.0	(2.0)
Installation Expense	(1.0)	0.0	0.0	0.0	0.0	0.0	(1.0)
Quality Related Expenses							
Product Recall	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Additional Parts Sorting	0.0	14.0	0.0	0.0	0.0	0.0	14.0
Contract Cancellation	0.0	0.0	0.0	0.0	0.0	0.0	0.0
New Business Hold	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Impact: Op Exp Items	(37.9)	9.0	(5.0)	(5.0)	(5.0)	0.0	(43.9)
CASH FLOW SUMMARY							
Cash inflows (outflows)							
Incremental benefit impacts	0.0	26.4	49.8	49.8	49.8	49.8	225.6
Incremental expense item impacts	(37.9)	9.0	(5.0)	(5.0)	(5.0)	0.0	(43.9)
Net Incremental CASH FLOW	**(37.9)**	**35.4**	**44.8**	**44.8**	**44.8**	**49.8**	**181.7**
Cumulative Net Incremental CF	(37.9)	(2.5)	42.3	87.1	131.9	181.7	181.7
Discounted Incremental Cash Flow							
At 9.0%	(37.9)	32.5	37.7	34.6	31.7	32.4	131.0
At 15.0%	(37.9)	30.8	33.9	29.5	25.6	24.8	106.6

For the year ending	Year 0 Oct 2003	Year 1 Oct 2004	Year 2 Oct 2005	Year 3 Oct 2006	Year 4 Oct 2007	Year 5 Oct 2008	TOTAL
Net Incremental CASH FLOW	(37.9)	35.4	44.8	44.8	44.8	49.8	181.7
Simple ROI		-7%	112%	230%	348%	479%	479%
Payback	1.1	Year					

Two Page Overview of Business Case

Reasons for preparing a business case

1. To put financial justification behind the decision to invest in RAM NDT technology.
2. To document both the financial and non-financial expected results of the investment.

Note: The system's ability to technically test the part needs to be established prior to undertaking a business case analysis.

Benefits to Top Tier

- Shows awareness of financial aspects of investment decisions through quantitative analysis
- RAM NDT acts as insurance policy against shipping bad parts. Objective measurement.
    - Business objective: **improving part quality shipped**
    - Important because it avoids costs associated with shipping poor quality parts
    - tangible measure: **100% parts inspection** by reliable, objective means
    - tangible result: **No quality reject and recall orders** from customers for part flaws
    - target for the *objective:* **zero defects**
    - target for the *benefit impact:* having no recall orders and maintaining current parts contracts
    - value of reaching the objective's target: **avoid recall and sorting costs** that can be extremely expensive
- Also used as de facto process monitoring system. If reject rate suddenly jumps, something in the process has changed and can be investigated.
- Has use as a process improvement tool. Can easily measure results of process improvement tweaks.
    - Business objective: **improving manufacturing process**
    - Important because it **reduces manufacturing costs** by making the manufacturing process more efficient
    - tangible measure: variance in scrap rates
    - tangible result: **maximized manufacturing efficiency**
    - target for the *objective:* **no process related defects**
    - target for the *benefit impact:* reduce scrap rate
    - value of reaching the objective's target: reducing scrap rate will result in a **reduction in production costs**
- Also reduces secondary operations costs by eliminating secondary operations on flawed parts
    - Business objective: **improving efficiency of secondary operations**
    - Important because it reduces overall manufacturing costs by eliminating secondary operations performed on flawed parts
    - tangible measure: **reduced machining costs**
    - tangible result: **extended machine tool life**
    - target for the *objective:* no secondary operations on flawed parts
    - target for the *benefit impact:* reduce overall tool wear
    - value of reaching the objective's target: reducing flawed parts receiving secondary operations will result in a reduction of machining costs.
- Acceptable tool to use for 100% inspection, increasingly contractually required.
- Can be used in concert with other methods of NDT or stand-alone depending on the fault being tested for.
- Dynamic measurements in the manufacturing process, like those achieved with the use of the RAM NDT-AUTO, puts Top Tier at the forefront of six sigma quality measurement. What gets measured improves. The system allows Top Tier to mitigate risk while aiding in process improvement capability.
- Inexpensive on-going maintenance costs (no continuous supplies to be purchased to run system)
- Acquisition cost is relatively low especially when considered in terms of end product recall costs.

Results obtained

- High ROI (2922% over 5 years) and short payback period (< 1 year) when potential recall costs of $400,000 are included
- Financially justified (ROI of 479% over 5 years) and short payback period (~13 months) based on process improvement/ monitoring capability of system even when potential recall costs are ignored.
- Numerous non-financial benefits of utilizing RAM NDT:
  - improved corporate image related to being known as a supplier of consistently good parts
  - competitive advantage related to high quality/low cost production ability
  - process monitoring to keep the manufacturing process running efficiently
  - marketing and sales benefits by being able to highlight quality achievements and awards
  - shared information with other Top Tier facilities for process improvement and cost saving ideas

Relevance of results to Top Tier

- The decision by Top Tier to add RAM NDT technology is a financially based business decision predicated on the business objective to avoid quality related costs.
- The purpose of the business case is to objectively quantify the financial results of avoiding those costs by the addition of the RAM NDT system.
- It provides a basis for decision-making based primarily on financial numbers, while also considering non-financial impact.

Conclusions

- Utilizing RAM NDT-SEMI as an end of line test stand has numerous advantages whether the manufacturing line is operating flawlessly or is turning out bad parts.
- When the manufacturing process is operating error free, it protects the integrity of the process and exposes variations.
- When the process generates a bad part occasionally, it identifies and contains the faulty ones before they get shipped to the customer and cause bigger headaches and costs for everyone.
- When the process becomes non-conforming, producing a larger number of bad parts, it acts as a sentry alerting the line personnel there is a problem and can help determine when the process is back in normal operating mode.

Recommendations

As can be seen from the **high ROI's** and **short payback period** of adding TMS' RAM NDT-SEMI system, as long as the system is technically able to determine the part fault being tested for, then investment in the system is a strong business decision with low financial risk. Avoid shipping bad parts, avoid recall expenses, avoid contract cancellation, avoid increased scrutiny on quality by customers, avoid new business hold, and the system has easily paid for itself.

Combine the **lowered financial risk** of being able to positively 100% inspect the ABS Control Bracket for part faults with the **process improvements** and the **process monitoring** uses for the system and the investment decision becomes even easier.

In the current market environment of automotive customers contractually requiring 100% parts inspection and zero defects becoming the de facto standard to remain competitive in the powdered metal parts market, a financially justified, reliable, repeatable, objective, low cost of ownership, NDT system is a required manufacturing tool.