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Original Paper

Using FMEA for Supply Chain Risk Management

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Abstract

Supply chain risk management (SCRM) is a key component of not only supply success but firm success as well. Supply chain risks can be mitigated to a great extent by the qualification and selection of the appropriate supplier. The purpose of this study was to identify how companies manage supply chain risks, with a particular focus on the use of Failure Mode Effects and Analysis (FMEA). The research was largely exploratory, so a purposeful sample was used. The research questions were explored in two steps. First, a survey was sent to of 67 perceived supporters of SCRM. Second, after review of the survey data, respondents who indicated they had used FMEA as part of a supplier qualification process were contacted. This research first uses survey data to determine that FMEA is seldom used for supplier risk assessment, but provides a powerful tool for proactive SCRM. A case study is then examined to determine that many of the fundamental principles of FMEA can be applied to reduce risk in supplier selection. This study shows that the supply chain can actually be managed in much the same way as product and process defects. This paper demonstrates that by showing how FMEA can play a major role in the process of managing risks through supplier assessment and selection.

Keywords

Supply chain risk management (SCRM), Failure Mode Effects and Analysis (FMEA), case study

1. Introduction

A key component of reducing overall corporate risk is supply chain risk management (SCRM) (Hauser, 2003; VanderBok et al., 2007). Proactive SCRM can lead to greater customer satisfaction, lower total costs, improved delivery performance and higher quality outcomes (Sodhi et al., 2012). There is currently no obvious single application for managing supply chain risks. Most firms are using existing supply chain applications for managing risk (Zsidisin 2003 a, b). In the absence of risk management applications, these firms are building risk considerations into traditional supply chain applications such as: initial supplier evaluations, financial risk assessment, supplier quality audits, capacity planning for operations and suppliers, lead time analysis for project management, supplier scorecard, management review, supplier risk analysis based on accounts payable performance, contingency plans, forecasting

techniques, and safety stock to name just a few.

While there has been some research on supply chain risk management, there are still more questions than answers (Zsidisin and Ellram 2003; Zsidisin et al. 2004). Sodhi et al. (2012) note that there is an "absence of any consensus on a definition or scope for supply chain risk." A number of processes of SCRM have also been proposed. Kleindorfer and Saad (2005) presented a three-step process: (1) specifying sources of risks and vulnerabilities, (2) assessment, and (3) mitigation, while both Jüttner et al. (2003) and Hallikasa et. al, (2004) suggest four step processes. Manuj and Mentzer (2008) provide a five step process, and Tummala and Schoenherr (2011) extend risk management process to supply chains. Clearly there is not yet agreement on what components and definitions constitute a "standard" supply chain risk management process. Sodhi et al. (2012) also note that "there is a shortage of empirical research in the area of SCRM" and this shortage is especially critical in addressing the question of current practice.

Jüttner (2005) has assessed the practice of SCRM, noting that "all traditional risk assessment processes/tools are being adopted more widely than the supply chain-specific processes" and that there is a "trend towards the less formalized and 'softer' tools." Failure mode effects and analysis (FMEA) has been suggested as such a tool (Teng et al. 2006; Welborn 2007). Documenting the likelihood and impact of risks must be a key part of managing the supply chain and managers must have access to readily available risk information to make decisions. FMEA is a tool used to collect such information related to risk management decisions (Roshan et al. 2003; Walewski 2002; Welborn 2007).

FMEA is a long-standing technique used to assess the risk failures in product and process designs. All potential failures are evaluated in terms of likelihood, severity, and detectability. A higher FMEA score implies higher risks. Common variables used to quantify risk are frequency of an activity associated with the defect, quantity of parts associated with the defect, ability to detect the defect, probability of the defect, and severity of the defect. A risk priority number (RPN) is calculated for each potential failure. A common RPN is the product of: probability of failure * detectability of failure * severity of failure (Carbone and Tippett 2004; Stamatis 1995; Welborn 2007). The steps to complete a FMEA are as follows: 1) Identify risk categories, 2) Identify potential risks, 3) Rate the opportunity, probability, and severity of each risk, 4) Calculate the RPN for each risk, 5) Analyze risks by RPN by using techniques such as a Pareto distribution. 6) Develop actions to mitigate risks with a high RPN, and 7) Reassess risks with another cycle of FMEA (Welborn 2007). The supply chain can actually be managed in much the same way as product and process defects. The remaining sections of this paper will demonstrate that by actually showing how FMEA can play a major role in the process of managing risks through supplier assessment and selection.

2. Research Method

The purpose of this study was to identify how companies manage risks through supplier assessment and selection, and if FMEA plays a role in that process. The research was largely exploratory, so a

purposeful sample was used (Eisenhardt, 1989; Miles & Huberman, 1994). The research questions were explored in two steps.

First, a survey was sent to 67 perceived supporters of the effort. The companies and people contacted were those which had supported supply management higher education and research programs, and were generally active in supply management professional organizations. Several industries were chosen for this study to achieve some level of generalizability. A 69% response rate was realized (46 responses). Most non-respondents indicated that either they did not have sufficient time to complete the survey or that company policy prevented them from discussing the particular research topics.

Second, after review of the survey data, respondents who indicated they had used FMEA as part of a supplier qualification process were contacted. One firm was asked to participate in follow up research to further explore supplier qualification and FMEA processes as they relate to risk management. The three authors conducted a semi-structured interview with the Supply Chain Manager and the Director of Supplier Development at an office furniture manufacturer.

3. Survey Results

The companies responding to the survey were based in North America and had global sales. Table 1 indicates that most of the responses (84.8%) were from manufacturing companies. Tables 2 and 3 list the sales and number of employees for each firm respectively. Table 4 provides job titles of respondents.

Table 1. Respondent industry profile

Description	Number
Manufacturing	
Automotive first tier suppliers	11
Automotive OEMs	4
Electronics manufacturers	3
Other (e.g., office furniture, home appliance, aerospace, medical equipment, plumbing fixtures, seats, recreational vehicles, etc.)	21
Non-manufacturing	
Distributors	3
Other (logistics, telecommunications, clinical testing, retailer)	4

Table 2. Respondent sales profile

Sales	Percent
$50M-$99M	4%
$100M-$499M	14%
$500M-$999M	7%
$1B-$9B	32%
$10B-$49B	34
$50B-$99B	7%
Over $100B	2%

Table 3. Respondent employment profile

Employees	Percent
Under 50	2%
50-99	2%
100-499	9%
500-999	5%
1000-4999	24%
5000-9999	9%
Over 10000	49%

Table 4. Respondent titles

	Percent
Procurement or Supply Chain Leader / Manager / Coordinator	37%
Supply Chain Director / Vice President	16%
Materials / Inventory Manager	16%
Strategic / Senior Buyer	13%
Plant Manager	6%
Supply Chain Analyst	6%
Account / Sales Director	6%

The survey consisted of multiple sections, including Likert scaled and open ended questions. Some sections addressed issues such as what were the greatest risks the companies faced and what were the common techniques for identifying and mitigating risks for example. This paper focuses on the results specific to FMEA.

Respondents were asked to indicate whether or not they used FMEA for SCRM. Depending on that response, respondents were directed to respond to an appropriate set of questions. The majority of

respondents (30 out of 46) indicated that they did not use FMEA for SCRM. Responses to open ended questions suggested that FMEA is reserved for high risk situations and is not used on a routine basis, as one firm indicated: "…we only use it in the very highest risk situations." Another manager commented that "I personally feel that most companies will not incorporate FMEA to all functional areas of the company. Unfortunately, it is and will continue to be considered a tool for engineering and quality until it is taught and pushed through supply chain issues."

Table 5 presents other reasons why FMEA was not used for SCRM, ranked from highest to lowest average. The general lack of knowledge regarding how to apply FMEA in a supply chain context seems to be the biggest challenge to more widespread adoption. Perhaps it is this lack of knowledge that keeps the explicit value of FMEA from being recognized – or perhaps it is the perceived lack of value that keeps firms from learning more about FMEA. Either way, the other reasons for not adopting FMEA do not seem substantial and likely could be overcome through more knowledge about the process and proving its value.

Table 5. Reasons why non-users do not adopt FMEA

ITEM	Mean	Std Dev
There is not enough knowledge of the FMEA procedure.	5.27	1.48
There is no noticeable "explicit" value yet.	4.43	1.79
It is not recognized or required by our industry.	4.21	1.64
FMEA is too time-consuming.	4.10	1.52
It is difficult for us to estimate failure modes using tools such as the FMEA model.	3.96	1.32
Not enough failures are experienced to justify using it.	3.62	1.82
It would not be compatible with our software or processes.	3.57	1.81
It is too confusing or complicated.	3.50	1.48
My organization is only considering future FMEA usage.	3.19	1.47
Never heard of FMEA.	2.69	2.38

1 = not an important reason, 7 = very important reason

The 16 firms that did use FMEA indicated it can provide substantial benefits (see Table 6). However, measuring the effectiveness of any risk reduction process by using standard supply chain performance measures (e.g., cost, quality) does not directly assess the relative success of the risk mitigation effort. It can only be inferred that the FMEA mitigated risks and thus supported better supply performance.

Table 6. Impact of using FMEA

The use of FMEA has led to:	Mean	Std Dev
Higher product quality.	5.74	1.24
Higher product reliability.	5.42	1.64
Better quality planning.	5.37	1.57
Continuous improvement in product and process design.	5.37	1.34
Lower manufacturing costs.	4.74	1.79

1 = strongly disagree, 7 = strongly agree

Table 7 indicates that FMEA processes can be improved, that FMEAs are intended to be applied globally, and that the effort is cross-functional though it needs to be championed by a few personnel. There are some concerns that the FMEA is executed consistently however. One manager suggested that FMEA has significant benefits "…if treated as the living document it is and if it used properly and consistently. [It is an] excellent tool for conveying lessons learned to current and new processes."

Table 7. FMEA Processes and Approaches

Item	Mean	Std Dev
The current FMEA could be improved in terms of organization and efficiency.	5.16	1.21
Customer requirements were used when developing FMEA.	4.95	1.84
Global suppliers of your organization are encouraged to implement FMEA.	4.74	1.73
FMEA is a group oriented assignment.	4.74	1.48
Management has provided the resources and provisions for enabling employees to use FMEA.	4.68	1.49
The FMEA process is the job of a few personnel and implementation is not widespread.	4.37	1.50
The FMEA process covers the entire global supply chain.	4.21	1.87
I would be more likely to use FMEA if our IT/ERP system included it.	4.16	1.64
FMEA is often too vague and causes confusion for those in the supply chain.	4.11	0.88
FMEA is applied in all functional areas of the company, including supply chain mgmt.	4.05	1.58
The process ensures the inclusion of input from both suppliers and customers in SCM.	3.95	1.39
Design requirements are defined in quantifiable terms to all parts of the supply chain.	3.58	1.26
The format of FMEA software and documentation is consistent within all participants.	3.32	1.42

1 = strongly disagree, 7 = strongly agree

Respondents were also asked what issue or source of difficulty a variety of factors have been with regard to FMEA usage. Table 8 groups these into three categories: Culture and Commitment, Knowledge and Skills, and Information. It doesn't appear that access to information is the key

challenge. Rather, culture/commitment and knowledge seem to be the major barrier to more widespread implementation (coupled with perceived need for FMEA). One manager suggested that FMEA "…is a tool utilized during green belt certification; however it appears for the most part it is put back in the 'tool box" to collect dust once individuals are certified." Another manager suggested that FMEA could be more effectively used at her firm: "Training and time. We need to train everyone on how to do them the *same* way, as consistency is necessary, and we need time and resources available to dedicate to this cause as everyone recognizes the importance."

Table 8. FMEA Issues and Sources of Difficulty

ITEM	Mean	Std Dev
CULTURE AND COMMITMENT	--	--
Lack of time, inability to work around members' schedules to set up time.	4.68	1.42
Team commitment, members know and understand the importance.	4.37	1.42
Getting the team involved, motivated, trained, and focused.	4.32	1.38
Lack of management support.	3.32	1.60
KNOWLEDGE AND SKILLS	--	--
Most personnel from various functions do not have adequate knowledge on failures.	4.74	1.63
Determining how much detail is necessary to complete the analysis.	4.53	1.35
Consistency in the assessment of each failure.	4.21	1.47
The ability to explain a defect clearly and understandably.	3.95	1.35
Identifying preventative actions for each failure.	3.84	1.38
Difficulty in identifying and ranking severity of the failures.	3.74	1.41
The team's ability to agree on potential failures and why they occur.	3.68	1.11
Confusion in FMEA terminology.	3.68	1.57
Finding Risk Priority Numbers (RPN).	3.58	1.07
Lack of creativity.	3.37	1.30
INFORMATION	--	--
Obtaining accurate quality information.	4.11	1.24
Finding reliable data.	4.11	1.29
Documenting all the data and requirements needed to complete the FMEA.	4.00	1.56
The ability to overlook sets of data that are needed to assess the severity of a failure.	3.79	1.47

1 = not an issue, 7 = major issue

This study also showed that documenting the likelihood & impact of risks was not a key part of supply chain management and that supply chain risk information was not readily available to key-decision

makers. Furthermore, very few of the firms were actually able to exploit risk to an advantage by taking calculated risks in the supply chain and even fewer were prepared to minimize the effects of disruptions. These questions were asked on 1 to 7 scale (strongly disagree to strongly agree): 1) A key part of our supply chain management is documenting the likelihood & impact of risks (mean=4.20, var.=2.86); and 2) Supply chain risk information is accurate and readily available to key-decision makers (mean=3.87, var.=2.78). There was some debate as to the validity and usefulness of tools to operationalize the process. The managers did tend to prefer approaches which combine subjective and objective measures because this allows them some freedom rather than being pushed into taking decisions solely on complicated numerical analysis.

Several of the firms used financial reports and questionnaires during supplier approval to compare supply candidates to the business requirements of the buyers or project teams. When justified by a perceived level of risk, a few of the firms went one step further and had candidate comparison matrices (e.g., supplier profiling form and supply chain FMEA). Additionally, most had formal processes for supplier visits (e.g., Rapid Plant assessment, site verification of the supplier questionnaire, etc.). Some firms actually used life cycle management with supplier report cards and their buyers would conduct periodic supply chain reviews. In one firm, sourcing was assigned risk ownership and they used FMEA principles to evaluate risk impact. For each risk, they would assess what the financial impact would be in the event of a disruption. They then assigned a probability to each risk area and then they prioritized by multiplying the financial impact by the risk probability. Again, most firms are only using existing supply chain applications for managing risk with no formal risk management system in place. In the absence of risk management applications, these firms are building risk considerations into traditional supply applications (e.g., spend, contract, & inventory management, demand planning, benchmarking, building long-term partnerships, etc). The case below highlights how FMEA is used to mitigate supply chain risks at an office furniture manufacturer that has requested to stay anonymous and will henceforth be referred to as Company1.

4. Company1 Background

Company1 is a global, publicly traded company with 2012 revenue of $2.75 billion and around 10,000 employees. They compete in the global office furniture industry with a portfolio that addresses three core elements of an office environment: interior architecture, furniture and technology. Suppliers provide design, production and service support and are a key to Company1's success. Suppliers are evaluated and selected using a range of criteria including sustainable business practices, financial stability, legal and ethical compliance, quality, cost, delivery and technical competence.

4.1 Failure Modes Effects and Analysis

In rare cases of extremely high risk, Company1 may conduct a complete FMEA. Only one FMEA in the supply chain has been conducted in the last seven years. It involved a new supplier and material that could have resulted in very high risk. The existing tools weren't sufficient to assess risk, so a

member of the Supplier Quality Group (SQG) who had been involved with design FMEA, utilized a cross-functional team to apply FMEA. It proved to be an effective tool, as the supplier was not pursued in large part due to this assessment.

The initial FMEA template and guidelines were developed using information gathered from published articles. Rather than gathering information by directly using the FMEA templates, the interview guide shown in Table 9 was used to simplify the interview process. This interview guide put FMEA topics into non-FMEA language and ensured that data gathered would be in terms familiar to the buyers. For example, the buyers would be asked “What do you see as potential problems or causes of problems? How severe are the problems? How often do you think this might occur? How could we detect the problem or know about it?”

Table 9. FMEA Worksheet

Cause / Problem statement	Result of problem	Severity	Occurrence	Detection	Action item	Assigned to	Target date

SQG then populated the FMEA form shown in Table 10. It is an Excel based form that guides the user. The “item and function column” in the FMEA would be populated using the terms recorded during the interviews so that the process and issues would be familiar to all stakeholders. Each project would have a new set of topics that were derived from the interviews.

Table 10. Supply Process FMEA

Supply Process Failure Mode Effects Analysis

Review team:				Process stakeholders:									Date		
Supplier:				Key project dates:							Tollgate 1 completed:				
Product:											Tollgate 2 completed:				
											Tollgate 3 completed:				
												Anticipated results due to proposed action(s)			
Item and Function	Potential Failure Mode	Effects of Failure	Projected Severity at 1st ship Rank 1 - 10	Cause(s) or Mechanism(s) of Failure	Projected Probability of Occurrence at 1st ship Rank 1 - 10	Key Process or Product Characteristic Yes/No	Current Design Controls	Projected Probability of Detection at 1st ship Rank 1 - 10	Ranking or Priority Number (Calculated 4X6X9)	Proposed Action(s)	Responsibility and Planned Completion Date	Severity Rank 1 - 10	Probability of Occurrence Rank 1 - 10	Probability of Detection Rank 1 - 10	Ranking or Priority number (Calculated 13X14X15)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Part and/or Product															
Liability									0						0
New Technology									0						0
Process Complexity (Delivery Performance)									0						0
Process Complexity (Cost)									0						0
Specifications (Incoming quality)									0						0
Business															
Core Competency									0						0
Ownership									0						0
Capacity									0						0
Quality System									0						0
Financial									0						0
Environmental									0						0
Facilities									0						0
EDI/TradeWeb									0						0
Relationship															
Segmentation									0						0
Finished Goods									0						0
Sole/Single/ Multi Source									0						0
Lead Time									0						0
Logistics									0						0

Each major heading in the FMEA has a comment box that provides instructions. Scales were developed for the severity, likelihood of occurrence and likelihood of detection columns as shown in Tables 11, 12 and 13. People generally agreed to and understood the meaning of the scales, but there was often disagreement regarding actual assignment of a number to a risk issue. The probability ranking was the most challenging because the ranges are more difficult to interpret and agree upon.

Table 11. FMEA Degree of Risk Severity Ranking

Degree of Severity Ranking		
Degree	**Description**	**Median Rating**
Very High	When a potential failure mode affects safe operation of the product and/or involves non-conformance with government regulations. May endanger people or product. Assign "9" if there will be a warning before failure, assign "10" if there will NOT be a warning before failure.	10 9
High	When a high degree of customer dissatisfaction is caused by the failure. Does not involve safety of people or product or compliance with government regulations. May cause disruption to subsequent processes/operations and/or require rework.	8 7
Moderate	When a moderate degree of customer dissatisfaction is caused by the failure. Customer is made uncomfortable or is annoyed by the failure. May cause rework or result in damage to equipment.	6 5 4
Low	When a failure will cause only slight annoyance to the customer.	3 2
Minor	When a failure is not likely to cause any real affect on subsequent processes/operations or require rework. Most customers are not likely to notice any failure. Any rework that might be required is minor.	1

Table 12. FMEA Degree of Risk Occurrence Rating

Degree of Occurrence Ranking			
Chance	**Description**	**Probability**	**Median Rating**
Very High	Failure is almost inevitable	1 in 2 1 in 3	10 9
High	Process is "similar" to previous processes with a high rate of failure	1 in 8 1 in 20	8 7
Moderate	Process is "similar" to previous processes which have occasional failures.	1 in 80 1 in 400 1 in 2000	6 5 4
Low	Process is "similar" to previous processes with isolated failures	1 in 15000	3
Very low	Process is "similar" to previous processes with very isolated failures	1 in 150000	2
Remote	Process is "similar" to previous processes with no known failures	1 in 1500000	1

Table 13. FMEA Degree of Risk Detection Ranking

Degree of Detection Ranking			
Degree	**Degree in %**	**Description**	**Median Rating**
Detection is not possible	0	Control method(s) cannot or will not detect the existence of a problem.	10
Very Low	0 to 50	Control method(s) probably will not detect the existence of a problem.	9
Low	50 to 60 60 to 70	Control method(s) has a poor chance of detecting the existence of a problem.	8 7
Moderate	70 to 80 80 to 85	Control method(s) may detect the existence of a problem.	6 5
High	85 to 90 90 to 95	Control method(s) has a good chance of detecting the existence of a problem.	4 3
Very High	95 to 100	Control method(s) will almost certainly detect the existence of a problem.	2 1

Agreement on a number was only part of the process. The greatest benefit of the process was the discussions enabled the team to identify the critical issues from a cross functional point of view. It was expected that people from different functions would perceive risk differently, so the discussions gave the team an opportunity to explore what the issues really were from a variety of perspectives. This process facilitates a fact-based decision-making agreement by following a process of engaging all the stakeholders in a formal risk review.

Though the FMEA proved to be effective, FMEA hasn't jumped out to Company1 as something that needs to become part of the standard tool set, so for the short term there likely will be limited use of supply chain FMEA. However, there is some consideration that FMEA will be updated as supply becomes more involved in new product development processes and to support the company's strategic objectives of moving into new markets. FMEA might be more efficiently adopted because as the Company1 supply manager indicated "I believe the process will become more acceptable since we are seeing an influx of people with engineering and quality backgrounds in our sourcing organization."

4.2 Finished Goods FMEA

One of Company1's highest risk supply issues is the purchase of "Finished Goods" (FG). FG items are delivered directly to a Company1 customer from the supplier, so Company1 does not see the FG prior to customer installation. FG items are generally low volume and specialized products that may require specific capital equipment. Items might include a special lighting fixture or a unique chair. Company1 still owns the FG design as the supplier builds to specifications.

There are two keys to mitigating FG risks. First, the initial supplier qualification process conducted by SQG provides confidence in the supplier process. Second, the FG services group, with support from SQG, conducts a "Probability/Likelihood of Discontinuance in Service" with associated "Severity/Impact" analysis on a periodic basis or when market conditions change (reference Table 14.)

This process is similar to, but it is not a textbook FMEA. This "scorecard" provides a closed loop analysis in the qualification and lifecycle management process.

Table 14. FG "Scorecard"

			Probability/Likelihood (discontinuance in service) **Weight per probability** **Viable financial stability 40%** **Change in ownership 20%** **Tier two reliance 20%** **Strategy Change 20%**				
supplier list							
Supplier	**Product**	**SCL**	**Viable- Financial Stability** **40% Weight** **1 Low** **2 Medium** **3 High**	**Change in ownership** **20% Weight** **1 Low** **2 Medium** **3 High**	**Tier two reliance** **20% Weight** **1 Low** **2 Medium** **3 High**	**Strategy change** **20% Weight** **1 Low** **2 Medium** **3 High**	**Overall probability**

			Severity/ Impact					
supplier list								
Supplier	**Product**	**SCL**	**Product Spend** **15% weight** **1 Very low** 0-100k **2 Low** 100k - 250k **3 Medium** 250k -500k **4 High** 500k - 1 MM **5 Very High** 1 MM - above	**Tooling Cost** **10% weight** **1 Very low** no tooling **2 low** Transferable / under 10k **3 Medium** 10k - 25k **4 High** 25k - 50k **5 Very High** 50k and above	**Product Criticality** **30% Weight** **1 Very low** **2 low** **3 Medium** **4 High** **5 Very High**	**Recovery time** **30% Weight** **1 Very Low** 1 to 4 wks recovery **2 Low** 4 to 8 wks **3 Medium** 9 to 12 wks **4 High** 3 to 6 months **5 Very High** 6 months or more	**Contingency sources** **15% Weight** **1 Very low** - off the shelf **2 Low** - multiple sources **3 Medium** -2- 5 available suppliers **4 High** - 1-2 suppliers **5 Very high** - proprietary products / process	**Overall Impact**
								0

5. Conclusion

Managers agreed that without a systematic technique to assess risk, much can go wrong in a supply chain (i.e., unexpected cost, extended lead times, poor quality, etc.). Analyzing the risk associated with SCM is a relatively new subject, and little has been done to assist managers with this process. But one thing is certain, documenting and analyzing risk must be an essential part of continuous improvement. It becomes critical to have an easily understood method to identify and manage risk.

FMEA is a mainstream tool used to collect information related to risk management decisions for most companies in an engineering capacity, but not in a supply chain capacity. There were several documented procedures to complete a FMEA across industries in this study, especially in automotive. Most managers supported a modified version of the tool that could be used to help evaluate the risk of SCM decisions. For several of the firms in this study, FMEA is a well documented and proven technique commonly used to evaluate the risk for failures in product and process designs. SCM decisions can be evaluated in much the same manner as product and process defects.

Most managers felt that proactive risk mitigation efforts applied to the supply chain is not common practice, but is required for minimizing disturbances. There was a general impression that with a FMEA based SCM risk assessment tool, unforeseen problems that might have impacted the success of SCM efforts can be avoided. Most managers want tools and procedures for implementing FMEA in a supply chain environment. They also want to know the critical success factors to the implementation process. Managers were concerned with the inconsistencies in the ranking of severity, occurrence, and detection and the inaccuracies that may delay effective FMEA implementation in a supply chain. Managers want guidelines for customers in correcting these problems in FMEA applications, so they can adopt and

integrate their FMEA process into a supply chain environment. The case example provides direction for managers by emphasizing that supply chain FMEA cannot be viewed as purely an engineering exercise, and by ensuring that the terms and measures used in FMEA are driven by the key stakeholders.

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