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THE BUSINESS CASE FOR SAFETY:

ASSESSING THE FINANCIAL VALUE OF SAFETY INVESTMENTS

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1 INTRODUCTION: Making a Business Case For Safety—a Dose of Reality

The standard treatment of safety risk in U.S. private sector companies is defined by compliance with Occupational Safety and Health Administration (OSHA) regulations. The presumption underlying this approach is that compliance by companies will ensure safe and healthful working conditions for workers. Following classical deterrence theory, as a means to discourage companies from breaching safety standards, OSHA carries out unannounced inspections to determine whether companies are compliant with standards. Breaches of standards involve sanctions by means of financial penalties corresponding with the seriousness of the violation. Companies are then required to take remedial action to meet the terms of the sanction within a specified timeframe. Sanctions are thus an essential element of OSHA enforcement and are key to driving compliance by ensuring there are consequences that will place the violating company in an inferior position compared to those companies that complied with their safety regulatory responsibilities.

However, the soundness of the compliance presumption as a means to deter safety risk remains an open question, particularly in light of conflicting research indicating that investments in compliance both boost and shrink[1, 2] company financial value. Adding to the confusion is circumstantial support from regulators,[3, 4] and professional associations,[5, 6] contending that investing in compliance would benefit workers with minimal cost to the company; conversely, critics[7-10] allege that investing in compliance is burdensome and costly for companies.

These competing predictions about the relationship between compliance and financial value make it difficult for companies to formulate effective safety strategy and for regulators to create effective safety regulation.

Moreover, the pattern expected for efficient markets would suggest that if compliance boosts financial value, it would become a company requirement, thus making compliance economically appealing for responsible companies competing with irresponsible companies that gain an economic advantage from disregarding compliance. When regulations shrink financial value, however, compliance would not become a company requirement and could actually increase safety risk if compliance investments divert funds from other potentially more effective safety investments. These circumstances suggest that market structures would resolve the question of compliance's financial implications; however, recent research suggests otherwise[11, 12]. The competitive strategy implications differ significantly depending on whether it is profitable for companies to invest in compliance, than if it is more profitable not to comply. This paper seeks broadly to advance an understanding of the business case for safety, specifically offering an adaptable way to calculate the financial value of not only compliance investments but also other types of safety investments that go beyond mere compliance.

This paper's emphasis on financial analysis for shaping other safety investment decisions should not be interpreted to diminish the importance of maintaining compliance with regulations. Concern for compliance is important and assessing the financial value of other safety investments in informing decisions is not intended to replace this concern. What safety investment analysis does provide, however, is an explicit way to calculate and value relevant safety costs and benefits with the aim of informing investment allocation decisionmakers of the circumstances of different investment options.

2

METHODS:
Ways and Means of the Study

The research was exploratory and inductive in nature because of the uncertainty and complexity of the subject matter. Exploratory research offered insight into the circumstances surrounding the research problem that has not been reached yet; while the inductive approach offered the means to answer how and why questions and generate new theory based on data. The research in this study considered the facility level of analysis, since the vast majority of prior research in the investment analysis literature has been conducted at this level. While our research purpose was to advance an understanding of the business case for safety, we also sought to add to the existing discourse and theory.

An examination of information published in peer reviewed journals and interviews with safety, design and process engineers; operations; financial specialists in high performance driven firms; safety officials in government and university researchers steered the research and development effort. The literature review revealed significant characteristics, inadequacies, consistencies and incongruities in the safety business case literature, while the interviews provided significant information about what a safety business case model should look like, beneficial outcomes to expect, internal organizational barriers to overcome and strategies to employ in overcoming those barriers.

3

RESULTS: Critical Summary of Current Practices

If safety managers are going to make and support claims about the financial value of investments in safety, they must do so understanding the process of adding to the current knowledge base. This requires explicitly stating knowns and unknowns about the matter and constructing an adaptable means to calculate the financial value of investments in safety. Based on a blending of the literature review and specialists interviews, the following are nine assertions about the business case for safety.

I The streams of research investigating firm level safety and financial performance should overlap, but they often do not. Seemingly lost in the literature is the interconnectedness of safety to financial performance. Moreover, the majority of safety studies time and again focus on outcomes (i.e., regulatory compliance, hazard control, impact assessment, and organizational climate/culture), not financial gain. The failure to include financial outcomes of safety leads to a poor performance basis for other routine business risk decision-making.

II The prevailing notion of financial investments in safety persists primarily because research has focused on regulatory issues rather than financial motives. Adding a financial perspective to safety investment decisions can provide safety, engineering, operations and financial specialists with additional insight into how the firm's existing, upgraded and newly proposed organizational activities (i.e., products, processes, technologies, and services) create risk and cost; failure to do so can compromise critical worker protection and operational decisions. For example, incomplete safety cost information can make it difficult to (a) identify the organizational activities driving life-cycle safety costs, (b) determine the appropriate safety management strategies and technical practices to pursue and the level of investment required and (c) estimate the potential financial value of safety investments over the short and long term.

III As a rule, the investment allocation decision-making process typically hinges on a firm's competitive strategy, its research and development competency, its technological capability and the capacity to productively use and protect organizational resources. Moreover, given that investment allocation decisions are heavily slanted toward financial aspects, the allocation of safety investments will usually be affected by the quality of safety financial analysis and the extent to which findings support the firm's investment conditions (e.g., MARR minimal accepted rate of return).

IV In general, safety does not hold a prominent place in the body of financial information considered relevant to investment allocation decision-makers. An uncertain grasp of the financial value of safety investments may well spur allocation decision-makers to underfund safety, especially in firms where financial considerations dominate and drive operational decision-making.

V Making the business case for safety has become an important business capability. Such a case depends on the ability of safety, engineering, operations and finance specialists to assess the financial value (positive/negative) of investments in safety and thereby compete effectively in the firm's investment allocation decision-making process. Whether pursuing funding to comply with regulations, control exposures to hazards, reengineer the safety management system, or improve organizational culture a compelling business case is basic. All of these actions might improve safety while simultaneously supporting business outcomes but they are different, and the business case for each of them is similarly likely to look quite different.

VI For the most part, the business case for safety relies upon understanding (a) the safety problems affecting organizational activities, (b) the risks and costs in doing nothing, (c) the costs of moving early to control risk, and (d) the financial value (positive/negative) of risk controls. Therefore, investments in safety as hedges against risk should be managed differently from other investments intended to pay off in the near future. The 1-year timeframe used by most firms is insufficient to evaluate the viability of safety investments. A longer time horizon of 3-5 years may be needed to fully capture benefits such as reduced risk and cost.

VII Typically, conventional accounting practice tends to focus on aggregating safety costs. This practice tends to hide safety costs in general overhead accounts and fails to account for the full range of life-cycle safety costs, preventing those costs from being allocated to the organizational activity responsible for their generation. In addition, because the return on investment for safety decisions is greatest when the decisions are made early in the life cycle, the failure to fully inform those decisions can increase risk and shrink firm financial value.

VIII Established safety-costing systems tend to suffer from imprecise cost collection and estimation schemes and fail to consider the financial returns that can be expected later from the investment, thus diminishing their decision relevance. (See Appendix A for a Safety Life-Cycle Cost Classification Scheme)

IX Because not all safety investments will have a positive net financial value, making a business case for safety does not necessarily mean delivering a positive financial payout to investment allocation specialists. It can also mean informing them about the costs that lie ahead to realize a particular safety benefit. This approach emphasizes a more limited question, namely: what cost is required to achieve a safety benefit? At what cost do safety investments succeed?

4

CONSTRUCTS: Safety Financial Analysis Framework

A systematic re-ordering of knowns and unknowns guided the development of the conceptual framework. The structural design of the framework **(Figure 1)** is comprised of three intermingled constructs, labeled as abridged lifecycle safety analysis; safety activity based costing; and net present value financial analysis, with each construct playing an integral role in making the business case for safety. The figure displays how the constructs merge into a framework and the accompanying narrative provides a brief explanation of the relationship of each construct to highlight the frameworks reasoning and functionality.

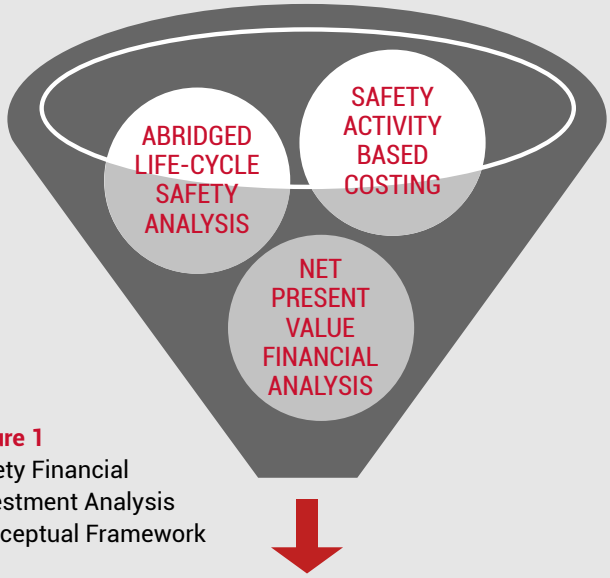


Figure 1
Safety Financial Investment Analysis Conceptual Framework

Abridged lifecycle safety analysis is a method to assess safety impacts of organizational activities throughout their productive/economic life cycle (e.g., pre-operational, operational and post operational). The life cycle of an organizational activity is the sum of all funds spent in support of the organizational activity from its concept development (e.g., pre-engineering design and specification setting), detail design (e.g., design of components, parts, subassemblies, process steps, and safety criteria), prototype testing, actual production/processing, use, disposal. Unlike the full lifecycle safety assessment[13], an abridged method[14] is less quantifiable and less thorough; it is, however, more practical to implement.

Safety activity based costing is an accounting method that allocates both direct and indirect safety costs to the organizational activities that generate the costs. This method provides a more accurate method of calculating safety costs that leads to a more accurate investment decisions.

Net present value financial analysis provides the most reliable means of comparing the financial value of mutually exclusive safety alternatives over a sufficient time horizon. By looking at the net present value from a safety investment and translating into today's dollars, one can determine more reliably whether the safety project is worthwhile. Other financial analysis of investments such as break-even analysis, payback period and internal rate of return tend to bias decisions away from safety investments. Although these tools are useful in the financial analysis of investment decisions, their exclusive use can result in making incorrect decisions, such as accepting safety proposals that lose money or rejecting safety proposals that may represent financial opportunities. Examples of safety investment analysis include facility site cost of owning safety, evaluation of existing safety costs and profitability of alternative chemical management options, cost of complying with new safety regulations, financial value of risk control capital investments, and financial value of in-house vs outsourcing industrial hygiene.

5

APPLICATION: Putting safety financial investment analysis into action

A three stage plan for conducting a safety financial investment analysis is presented here and outlines ways for (1) defining and setting the boundaries for managing the investment analysis, (2) conducting an abridged safety activity based life cycle net present value analysis, and (3) conducting post implementation look backs to verify that the results of implemented solutions are in reasonable agreement with the estimated projections.

STAGE 1
ANALYSIS DEFINITION AND BOUNDARY

Stage 1 should specify the type and scope of the safety financial investment analysis, specifically attending to the following components:

I a description of the existing, upgraded or new organizational activity,

II its expected economic/productive life (i.e., the estimated amount of time that investments in the organizational activity can be expected to have economic value or productive uses and the estimated amount of time that recurrent savings and reduced risk can be achieved without having to re-invest at the same level in the initial investment),

III the firm's hurdle rate (i.e., the required rate of return in a discounted cash flow analysis that the firm is using to judge investment proposals) and,

IV the existing and potential safety issues (e.g., risk & danger) linked to the organizational activity under analysis.

To keep the analysis on course and focused, it is important that the design and organizational intent of the analysis are transparent and stated upfront. Elements to consider include:

I purpose and objectives, analytical assumptions/limitations, methodology (i.e., data collection, analysis and interpretation and reporting procedures) and how information will be used to drive decision-making,

II a management, procurement, law, environment, safety and health and community relation should be identified to participate in the analysis,

III a process flow diagram of both the existing organizational activity and the proposed solution change that depicts upstream inputs and downstream outputs, the existing and new system composition and history, current and potential performance problems, existing and new system capabilities, limitations, and beneficial outcomes expected because of the change should be stated.

STAGE 2
INVENTORY ANALYSIS AND IMPACT ASSESSMENT

The intent of stage 2 is to conduct an inventory analysis (i.e., the identification and quantification of resource inputs such as capital, resources/materials/supplies, labor and outputs such as risk) and impact assessment (i.e., qualitative and quantitative classification, characterization and valuation of risk impacts).

It is also important to provide investment allocation decision-makers with estimates of the firm's capacity to control or improve the existing safety risk. Examples include:

| funding capability (i.e., the existing level of funding available to control the safety issue). A high level of funding indicates that the firm has the financial means to effectively control or improve the issue, whereas a low level of funding indicates that the firm has little financial means by which to address the issue in the immediate future,

|| human-operational capacity (i.e., the existing level of human-operational wherewithal to control the safety issue). A high level of wherewithal indicates that the firm has the human means and capability to control or improve the issue, whereas a low level of wherewithal indicates that the firm has little human-operational means by which to address the issue in the immediate future,

||| available technology (i.e., the existing level of technology that is available to control the safety issue). A high level of available technology indicates that the firm can acquire technology as a way to control or improve the issue, whereas a low level of available technology indicates that the firm has little technological means by which to address the issue in the immediate future.

STAGE 3
POST-IMPLEMENTATION LOOK BACK

With any investment in safety, it is important to verify that the results of implementing solution changes are in reasonable agreement with the estimated projections. If a new technology was purchased because of potential reductions in risk and cost, it is important to see whether those benefits are actually being realized. If not, a review should be performed to identify what has been overlooked. A post-implementation look back helps to uncover reasons behind the inaccuracy, such as overly optimistic financial estimates. This information would help ensure that mistakes in investment cost projections can be avoided in the future. In order to ensure that financial calculations are realistic, everyone involved must know that a review of results will take place. Therefore, a post-implementation review should be conducted three to twelve months after a mutually exclusive alternative has become operational, as well as regularly afterwards.

Two beneficial outcomes should be expected and leveraged when conducting safety investment analyses. First, at the senior-management level, safety investment analysis provides executives with an improved appreciation of the connection between safety and firm financial value. Secondly, at the mid-management level, this analysis delivers operational insights to engineering, operations and financial personnel so that impacts can be analyzed side-by-side with product and process production concerns. In order to take advantage of these leveraging opportunities, there are internal organizational barriers to overcome when applying safety financial investment analysis. First, a senior level executive point of view that proposals for investments to counteract safety issues are not financially structured or reported in a manner that allows the safety function to compete with other investment proposals within the firm. Second, an engineering level point of view that the existing strategy and methodology for performing economic analysis of safety issues and practices that affect new organizational activity designs are qualitatively and quantitatively immaterial for enhancing design and process changes. Third, an operations level point of view that safety issues linked to the firm's processes are primarily compliance based and thus play a very small part in the investment allocation decision process of the firm. These barriers are significant and should be overcome in order to effectively compete in the firm's investment allocation decision-making process. The strategy expected to be the most effective in overcoming these barriers is to employ safety investment analysis in a manner that discloses internal safety related costs throughout the productive/economic life cycle of the firm's organizational activities, revealing the financial impact that investments in safety practices have on these organizational activity designs.

6

CONCLUDING COMMENTS

Typically, the concern for safety and for firm financial value have been viewed as separate lines of attack, operating independently of and usually in opposition to one another. However, the increasing interdependence between these concerns highlights the need to demonstrate some type of financial connection in order to advocate for safety investments. Safety specialists have not generally incorporated investment analysis as a way of quantifying the contribution of safety investments to firm financial value. As a result, safety concerns tend to be seen only as a necessary cost of doing business—with little financial advantage expected - left out of the firm's investment allocation process and excused from the expectation to justify their internal and external affairs from a financial perspective. This limited mindset, however, provides little support to campaign for safety investments. Only a focus on the results of investment analysis can provide investment allocation decision-makers with the necessary information to set investment allocation priorities.

In this white paper, we have asserted that making a successful business case for safety requires insight into the safety problems affecting organizational activities, the risk and cost of doing nothing, the costs of moving early to control risk and cost and the financial value of risk controls. Such insight is most likely to convince investment allocation decision-makers to support safety, as well as strengthening integrated decision-making among safety, engineering, operations and financial specialists to improve worker protection. We have contended and the literature and interviews have supported that the costs of compliance, with no positive financial return, is no reason to argue against any real benefits arising from compliance. However, that argument has ignored a basic point that complying with safety law or any other law usually does not yield a positive financial return. A broader approach is necessary, one that focuses on basic changes in products, processes, services, technologies, and business strategies that offer opportunity financially as well as legal. We also have contended and the literature and interviews have supported that making a business case for safety is not only an important business capability, but also a strategic bet against risk. Because it would be unreasonable to suppose that safety investments would all have a positive present financial value, making a business case does not necessarily mean delivering a positive financial payout; it can also mean informing investment decision-makers about the life cycle risk and cost that lie ahead to realize a particular safety benefit. This approach reorients the business case for safety around a more limited question, namely: **at what cost does the safety benefit come?**

In summary, this paper has explored the financial impact of investment in safety, as it has been described in both research and competing predictions/accounts from regulators, professional societies and non-regulators. As an overall observation, safety business case studies do not have a strong tradition in any published journal; the limited literature that does exist are not founded on a previous discourse, are anecdotal, suffer from poor proxies and often based on case studies some of which fail to translate from their controlled research based work settings to the executive suite. This paper has clarified what is known and what is unknown, ultimately providing a new perspective and proposing an adaptable conceptual framework for making a business case for safety. However, many issues remain to be addressed; especially the role investments play in reducing safety risk. These questions call for further evidence-based studies, as well as refinement of existing software tools that at present offer only incomplete calculations of the financial value of safety investments.

REFERENCES

[1]Lee, G. (2018). A Systematic Review of Occupational Health and Safety Business Cases. *Workplace Health & Safety, 66*(2), 95–104.

[2]Verbeek, J., Pulliainen, M., & Kankaanpää, E. (2009). A systematic review of occupational safety and health business cases. Scandinavian Journal of Work, Environment & Health, 403-412.

[3]Occupational Safety and Health Administration. (2006) Business Case for Safety and Health. United States Department of Labor. Retrieved from https://www.osha.gov/dcsp/products/topics/businesscase/costs.html

[4]National Institute for Occupational Safety and Health. (2018). Make the Business Case: How *Total Worker Health* Approaches Can Benefit Both Your Workers and Your Organization. (CDC) Centers for Disease Control and Prevention. Retrieved from https://www.cdc.gov/niosh/twh/business.html

[5]American Society of Safety Professionals. (2002). White Paper Addressing the Return on Investment for Safety, Health and Environmental (SH&E) Management Programs.
6National Safety Council. (2013). The Business Case for Investment in Safety – A Guide for Executives. Retrieved from https://www.nsc.org/work-safety/tools-resources/safety-for-business/what-is-journey

[7]Arocena, P., & Núñez, I. (2009). The Effect of Occupational Safety Legislation in Preventing Accidents at Work: Traditional versus Advanced Manufacturing Industries. *Environment and Planning C: Government and Policy, 27*(1), 159–174.

[8]Bradbury (2006) Regulatory federalism and workplace safety: evidence from OSHA enforcement, 1981–1995. *Journal of Regulatory Economics 29*:211–224.

[9]Levine DI, Toffel MW, Johnson MS (2012) Randomized government safety inspections reduce worker injuries with no detectable job loss. *Science 35 336*(6083):907-911.

[10]Viscusi W, Vernon, J, Harrington, J. (2000) Economics of Regualtion and Antitrust 3rd edition (MIT Pres, Cambridge, AM)

[11]Jacobs, Brian & R. Singhal, Vinod. (2017). The effect of the Rana Plaza disaster on shareholder wealth of retailers: Implications for sourcing strategies and supply chain governance. *Journal of Operations Management.* 49-51. 10.1016/j.jom.2017.01.002.

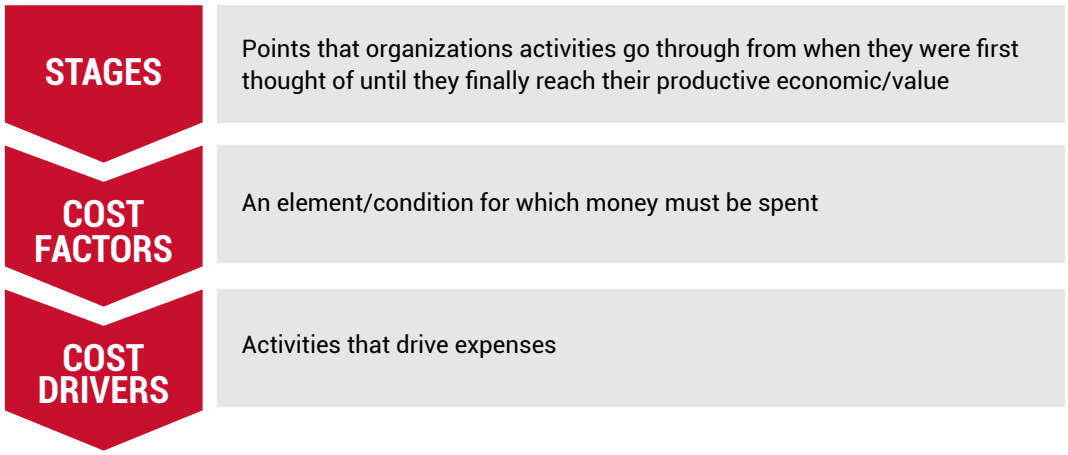
[12]Kirchoff, J. F., Omar, A. and Fugate, B. S. (2016), A Behavioral Theory of Sustainable Supply Chain Management Decision Making in Non exemplar Firms. J Supply Chain Manag, 52: 41-65.

[13]Society of Environmental Toxicology and Chemistry. (1991). A Technical Framework for Life Cycle Assessments. Washington D.C., Society of Environmental Toxicology and SETAC Foundation for Environmental Education, Inc.

[14]Graedel, T., B. Allenby, and Comrie, R. (1995). Matrix Approaches to Abridged Life-Cycle Assessments. *Environmental Science and Technology,* No. 29.

APPENDIX A

Abridged Safety Life-Cycle Cost Classification Scheme



DEFINITIONS

I. PRE OPERATIONAL STAGE

The stage where safety risks linked to organizational activities are uncovered during engineering design and where safety criteria is incorporated into the design engineering process. This stage aims to prevent later risk and cost burdens during the operational and post operational stages.

1. Cost Factor (Due Diligence)

Cost Drivers (Profiling Safety Risk/Cost)
Assessing potential exposures to hazards stemming from existing and new/upgraded organizational activities and planning control measures. The costs linked to due diligence activities include hours expended to bring it to a decision.

2. Cost Factor (Acquiring Safety Permits & Capital Equipment, if necessary)

Cost Drivers (Obtaining Safety Permits, if necessary)
Activities to obtain safety permits to ensure that the existing and new/upgraded organizational activities comply with local regulations *(e.g., handling, storing, transporting hazardous substances and associated wastes)*. The costs of permits include its purchase price and all other costs incurred to bring it to a form suitable for its intended use. Examples include:

a) Permit review/approval, activities performed to study the procedural and performance requirements, make application and signoff on permit contract,
b) Permit fee, the direct cost associated with the permit,
c) Process reengineering, activities performed for reengineering and remodeling the manufacturing process infrastructure to comply the procedural and performance requirements of the permit, including capital safety equipment, installation and utility hook-up expenses.

Cost Drivers (Acquiring Safety Capital Equipment, if necessary)
Activities to obtain safety capital equipment-areas-structures *(e.g., hazardous control equipment for reducing, neutralizing, minimizing the volume, toxicity and hazardous properties of material waste, monitoring devices for providing periodic/continuous surveillance, detecting, and recording of exposures to process hazards, treatment/storage/disposal equipment for dealing with waste generated by the process, including the consolidation of waste until shipping, fire and security, emergency and disaster management)*. The costs of capital equipment include its purchase price and all other costs incurred to bring it to a form and location suitable for its intended use. Examples include:

a) Safety capital review & sign-off, activities performed to study capital equipment alternatives, qualify suppliers; develop, negotiate, sign off on equipment contracts, and make ready the factory and manufacturing process to receive equipment.
b)Equipment cost, the direct costs associated with ESH capital equipment, including spare parts,
c) Process reengineering, activities performed for re-engineering and remodeling the manufacturing process infrastructure to accommodate ESH capital, including equipment installation and utility hook-up expenses.

II. OPERATIONAL STAGE

The stage where safety risks uncovered in the pre-operational phase that were not eliminated, are made transparent to process specialists and where risk control measures established.

3. Cost Factor (Operating Safety Capital)

Cost Drivers (Capital Cost of Ownership)
Annual cost associated with operating/owning safety capital structures). Examples of costs include: utilities, labor, supplies/ materials, maintenance.

4. Cost Factor (Safety Consumables)

Cost Drivers (Annual usable supplies)
Annual cost of consumables used by process or factory site examples include:

Safety, industrial hygiene, ergonomics, equipment -supplies for providing employee protection against exposure to process hazards.
Environmental protection supplies for preventing, controlling & treating environmental incidents.
Environmental packaging equipment - supplies for consolidating-protecting-improving the handling of waste.
Hazardous Material Management equipment -supplies for providing environmental incident response and recovery.
Fire protection equipment -supplies for providing fire prevention and incident control services.
Emergency & Disaster Management for responding and recovering from incidents.
Security equipment-supplies for providing process and factory site monitoring and surveillance.
License/certificates for complying with safety regulations.

5. Cost Factor (Management/Technical Support)

Cost Drivers: (Safety Integration)
Annual costs associated with providing safety strategic and technical support to the process or factory site. Examples include: strategic management activities such as safety process strategic planning, reengineering, audits, managing contracts, technical support activities such as identifying, evaluating, and controlling exposures to hazards, advising on regulatory compliance matters; manifesting and recordkeeping, research/development activities such as testing, conducting studies and creating innovative ways to protect and use process resources productively, safety training to the process or factory site related to regulatory compliance required for maintaining compliance with regulatory laws and standards and process specific for developing special safety competencies and capabilities.

III. POST OPERATIONAL STAGE

The stage concerned with retiring the process at the end of its useful life and preparing the area for other productive uses.

6. Cost Factor (Decommissioning)

Cost Drivers: Activities associated with retiring the manufacturing process following its useful/productive life, examples include: decommissioning review, activities performed for profiling the ESH risk and cost burdens associated with retiring the manufacturing process or factory site, dismantling/cleanup, activities required to disassemble components used in the manufacturing process, arrange for disposal, and conduct cleanup procedures and component shipping and disposal costs incurred for transporting and disposing of dismantled components.

IV. ACCIDENT/NON-COMPLIANCE STAGE

The stage concerned with responding and recovering to accidents when risk control measures were deficient and/or not effective during the production and post operation stage and dealing with non-compliance violations.
Note: Activity costs incurred as a result of accidents and non-compliance fines are considered one-time costs. However, accident cost because of reserved costs may occur in subsequent years.

7. Cost Factor (Accidents)

Incidents that only affect the manufacturing process and tend to result in (1) an adversity or disablement to a resource, (2) incurred direct and indirect costs, and (3) production interruption to the process.

Cost Drivers:
Direct Costs. Those costs that can be easily identified and calculated or directly assigned to the incident with a high degree of accuracy e.g., employee financial compensation (both current and reserved), damaged manufacturing property resources, capital replacement expenditures, incident fines, and legal expenses.

Indirect Costs. Those costs that can be intangible and difficult to calculate in the short term e.g., incident investigation, production delays, loss of training investment, loss of future contribution of employee, replacement of resources, claims management, incident response- recovery-remediation, and business resumption.

8. Cost Factor (Non-Compliance Fines)

Citations issued for failing to comply with federal, state or local environmental, safety and health agencies.

Cost Drivers:
Direct Costs. Those costs that can be easily identified and calculated or directly assigned to the fine with a high degree of accuracy, e.g., financial payment for the citation, make the facility and the process ready to comply including any capital expenditures, materials, labor, legal fees and research.

Indirect Costs. Those costs that can be intangible and difficult to calculate in the short term, e.g. activities needed to study and contest the fine.

SUPPLEMENT A

Safety Investment Analysis Illustration #1 *(Ergonomic Worker Lifting Exposure)*

General Analysis Information	Operational Defaults	Financial Defaults
Name & Location of Facility: Clearlite Plate Glass Company, Clarksburg, WV Time Data Based On: 01/02/2019	# of Full time (Line Level Employees) & labor rate cost 2000 / $25.00 # of Full time (Management Employees) & labor rate cost 125 / $100	Factory Units Produced 2019 = 100,000 Expected Economic/Productive Life = 5 yrs Hurdle Rate = 15% Corporate Tax Rate = 40%

Financial Analysis Summary

Purpose of Analysis:	**Option 1:**	**Option 2:**	**Outcomes Expected:**
To understand the financial value of investments in controlling chronic occurrence of lifting related risk across three (3) packaging lines. In spite of administrative controls including: job rotation, stretching and training, these production lines are high risk and expensive in terms of injury costs $64,000/year. To control for lifting risks this proposal requests purchasing of vacuum lifting equipment at each packaging line.	Do Nothing $15,000/year $.15 cost/unit **$30,169 NPV**	Purchase Equipment $32,000/year $.32 cost/unit **$102,333 NPV**	Risk: Reduced exposure to lifting risk, accidents **Incremental NPV = -$72,164**
I. Pre Operational Cost Area		**$117,000**	
Phase 1. Due Diligence *(one time costs)*		**2,500**	
1. Profiling Safety Risk / Cost Impact		2,500	
1.1 Exposure Assessment & Control		2,500	
Phase II. Acquisition *(one time costs)*		**117,000**	
2. Safety Permits		4,000	
2.1 Permit Review		2,500	
2.2 Permit Fee		1,500	
2.3 Re-engineering Facility Process		-	
3. Safety Capital Equipment		113,000	
3.1 Equipment Review & Sign-off		3,000	
3.2 Equipment Cost		90,000	
3.3 Re-engineering Facility Process		20,000	
Annual Depreciation		-20,340	
Salvage Value		-11,300	
II. Operational Cost Area *(annual costs)*	**15,000**	**7,800**	
Phase III. Use	15,000	7,800	
4. Running Safety Capital Equipment		3,300	
4.1 Utilities		1,500	
4.2 Labor			
4.3 Supplies/Materials		900	
4.4 Preventative Maintenance/Maintenance		900	
5. Safety Consumable Supplies	10,000	4,500	
5.1 Safety, Industrial Hygiene, Ergonomics	10,000	2,000	
5.2 Environmental Protection			
5.3 Environmental Packaging			
5.4 HAZMAT			
5.5 Fire Prevention/Protection			
5.6 Emergency/Disaster			
5.7 Security Monitoring			
5.8 License/Certificates			
6. Management/ Technical Support			
6.1 Training, Auditing, Recordkeeping, etc	5,000	**1,500**	
III. Post Operational Cost Area		1,500	
Phase IV. Decommissioning *(one time costs)*		1,500	
7. Retiring the activity		1,500	
7.1 Dismantling & Clean-up		1,000	
7.2 Disposal		500	

SUPPLEMENT A

Safety Investment Analysis Illustration #2 *(Controlling Noise Exposure)*

General Analysis Information	Operational Defaults	Financial Defaults
Name & Location of Facility: Clearlite Plate Glass Company, Clarksburg, WV Time Data Based On: 01/02/2019	# of Full time (Line Level Employees) & labor rate cost 2000 / $25.00 # of Full time (Management Employees) & labor rate cost 125 / $100	Factory Units Produced 2019 = 100,000 Expected Economic/Productive Life = 5 yrs Hurdle Rate = 15% Corporate Tax Rate = 40%

Financial Analysis Summary

Purpose of Analysis: To understand the financial value of noise control investment options affecting 2,000 line level workers (do nothing) (purchase noise dosimeters & internal staff manage) (outsource). Disposable earplugs $50/employee/year.	**Option 1** Do Nothing $115,000/year $1.15 cost/unit **$231,299 NPV**	**Option 2** Conduct in-house $122,000/year $1.22 cost/unit **$247,355 NPV**	**Option 3** Outsource $17,000/year 0.17 cost/unit **$36,169 NPV**	**Outcomes Expected:** Risk: Reduced exposure to hazardous noise and PPE & audiogram costs. Option 3* Incremental NPV = $195,130
I. Pre Operational Cost Area		**10,000**	**10,000**	
Phase 1. Due Diligence *(one time costs)*		10,000	10,000	
1.Profiling Safety Risk / Cost Impact		10,000	10,000	
1.1 Exposure Assessment & Control		10,000	10,000	
Phase II. Acquisition *(one time costs)*				
2. Safety Permits				
2.1 Permit Review				
2.2 Permit Fee				
2.3 Re-engineering Facility Process				
3 Safety Capital Equipment				
3.1 Equipment Review & Sign-off				
3.2 Equipment Cost				
3.3 Re-engineering Facility Process				
Annual Depreciation				
Salvage Value				
II. Operational Cost Area *(annual costs)*	**115,000**	**155,000**	15,000	
Phase III. Use	115,000	155,000	15,000	
4.Running Safety Capital Equipment				
4.1 Utilities				
4.2 Labor				
4.3 Supplies/Materials			10,000	
4.4 Preventative Maintenance/Maintenance				
5. Safety Consumable Supplies				
5.1 Safety, Industrial Hygiene, Ergonomics	100,000	105,000		
5.2 Environmental Protection				
5.3 Environmental Packaging				
5.4 HAZMAT				
5.5 Fire Prevention/Protection				
5.6 Emergency/Disaster				
5.7 Security Monitoring				
5.8 License/Certificates				
6.Management/ Technical Support				
6.1 Training, Auditing, Recordkeeping, etc	15,000	50,000	5,000	
III. Post Operational Cost Area				
Phase IV. Decommissioning *(one time costs)*				
7. Retiring the activity				
7.1 Dismantling & Clean-up				
7.2 Disposal				