

The Business Case for **PROCESS SAFETY**

4th Edition





SINCE 1985, The Center for Chemical Process Safety (CCPS) has helped manufacturers, insurers, government, academia, and consultants work together to improve process safety. CCPS and its members are committed to protecting employees, communities, and the environment by developing engineering and management practices to prevent or mitigate catastrophic releases of chemicals, hydrocarbons, and other hazardous materials.

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Center for Chemical Process Safety of the American Institute of Chemical Engineers
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**CENTER FOR CHEMICAL
PROCESS SAFETY
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It is sincerely hoped that the information presented in this document will lead to an even more impressive safety record for the entire industry; however, the American Institute of Chemical Engineers (AIChE), its consultants, the AIChE's Center for Chemical Process Safety (CCPS) Technical Steering Committee and the Project 285 Subcommittee members, their employers, their employer's officers and directors, and Scott Berger and Associates LLC and its subcontractors do not warrant or represent, expressly or by implication, the correctness or accuracy of the content of the information presented in this book. As between (1) the AIChE, its consultants, the CCPS Technical Steering Committee and Subcommittee members, their employers, their employer's officers and directors, Scott Berger and Associates LLC and its subcontractors, and (2) the user of this document, the user accepts any legal liability or responsibility whatsoever for the consequence of its use or misuse.

What separates the top-performing chemical, oil, gas, and related companies from the rest?

IN ONE WORD, SUSTAINABILITY. Without sustainability, a company may have a streak of strong quarter-over-quarter growth. But that ultimately ends, sometimes spectacularly. Financial decline is also precipitated by causes other than process safety incidents. However, declines frequently involve the same kinds of leadership and management system failures that precipitate process safety incidents.

Sustaining a high level of process safety performance leads to numerous benefits. Benefits appear in top line revenue, bottom line profit, cash flow, company valuation, and stock price. This requires leadership – the kind of strong, felt, leadership that benefits other business areas as well.

This, in short, is the fundamental Business Case for Process Safety. *A company which integrates strong leadership and management of process safety into the heart of its business reaps numerous benefits.*

This finding originated from a study conducted by the Center for Chemical Process Safety (CCPS) between 1999-2002. Incidents since that time have only provided further evidence for this conclusion, leading to this 4th edition of the publication.

Based on recent industry experience, process safety benefits companies in five ways. All these benefits make it indispensable for companies of all sizes to achieve manufacturing excellence and increase profitability and shareholder value.

THE BUSINESS CASE FOR PROCESS SAFETY

“We have seen process safety benefit our business in many ways. It made us competitive and it certainly has helped our bottom line.”

ARNEL SANTOS
SVP Operations
NOVA Chemical Corporation



The Five Benefits of Process Safety

THE BENEFITS OF PROCESS SAFETY



"I commend CCPS for this work because recent incidents have shown an even stronger link

between process safety excellence and sustainable growth. We have seen process safety benefit our business in many ways. Process safety excellence enabled us to be actively sought after and become a partner of choice. It made us competitive and it certainly helped our bottom line. Process safety is a fundamental tenet of every successful business."

ARNEL SANTOS
SVP Operations
NOVA Chemical Corporation



A BUSINESS CASE for process safety should not be necessary. The need to protect workers, the community, and the environment is as obvious as the need to protect market share, provide & protect shareholder value, and make payroll. But with the many daily demands of business, the obvious can sometimes be left behind. When a company leaves process safety behind, they miss significant financial and organizational benefits described in this publication.

This benchmark survey of CCPS member companies, combined with data from other sources, provides conclusive evidence that methodically implementing process safety delivers five benefits that help the company to sustainability. These benefits range from quantitative to more qualitative, and from value creation to cost reduction.

The Benefits

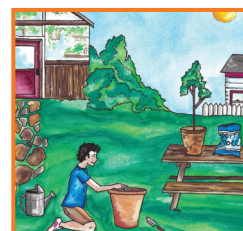
1. Corporate Social Responsibility

Process safety helps make a company more attractive to employees, communities, governments, insurers and investors. This opens the door to the second benefit...



2. Business Flexibility

Companies considered welcome by communities and governments can expand and evolve with fewer social or political barriers. Equally important, major incidents can sap human and financial resources that could otherwise be focused on growth. Process safety helps give companies the ability to determine their own future by avoiding them.



3. Loss Prevention

Any major process safety incident results in an obvious direct financial loss. However, losses can extend beyond onsite and offsite damage and injuries. Especially with severe incidents that cause property & environmental damage, companies can suffer adverse financial losses including cash shortfalls, sometimes forcing asset sales often at significantly below their value.

4. Sustainable Growth

Process safety requires that processes be well-controlled and reliable, and that every person in the organization fulfills their process safety responsibilities faithfully. This results in increased productivity and quality.



5. Leadership Excellence

Process safety requires heartfelt and involved leadership, as well as rigorous management to ensure responsibilities are carried out consistently and reliably. These practices carry over to all other business areas.

WHAT IS PROCESS SAFETY?

PROCESS SAFETY is a management system which controls a wide range of operational, cultural, and technical activities essential for preventing incidents involving hazardous materials. It applies wherever chemicals, oil, gas, or combustible dust are produced, handled or used.

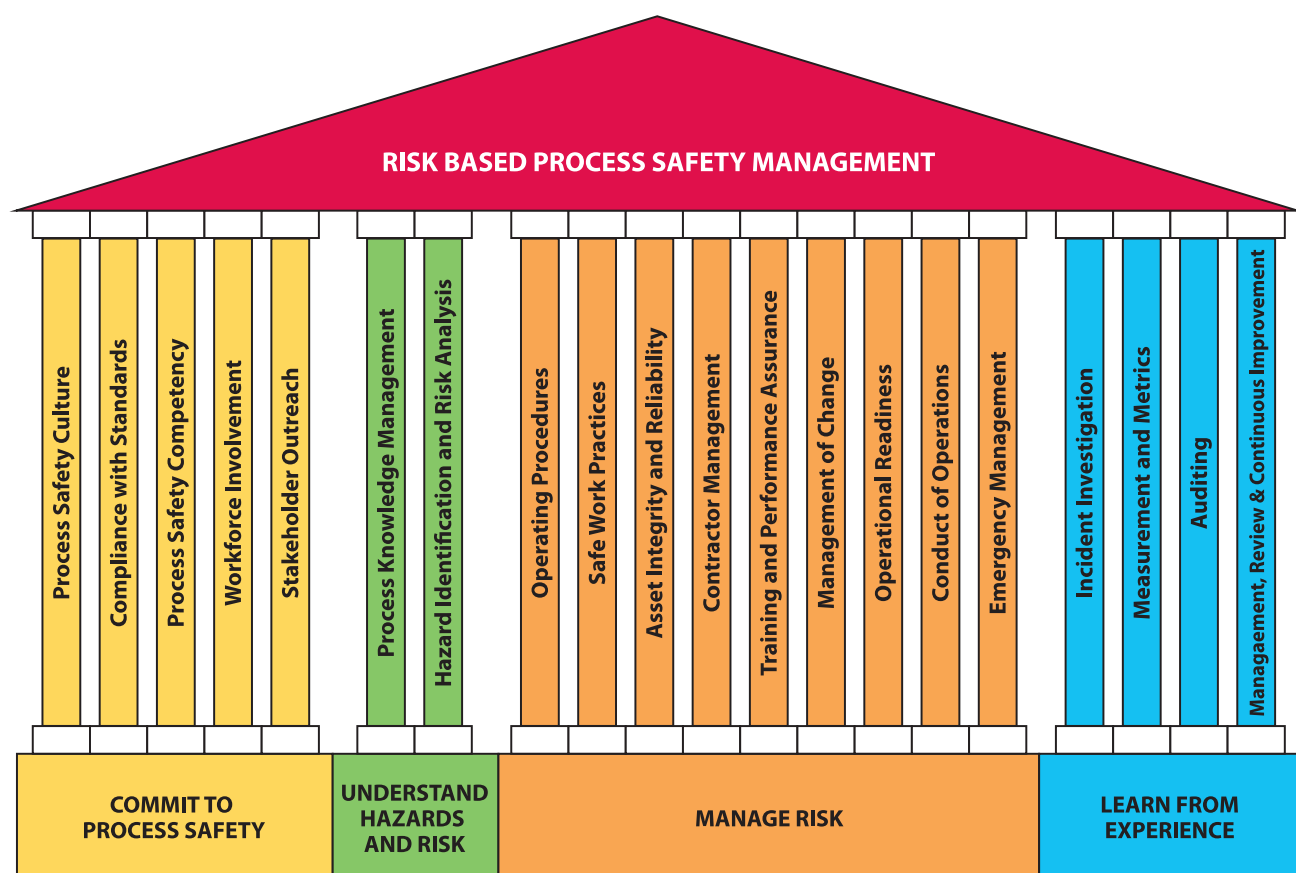
There are process safety management systems (PSMS). Some are based on regulations, some on guidelines or standards, and others internally developed by companies. All require the basic features identified in the CCPS Risk Based Process Safety Management System approach.

Companies should implement a PSMS to ensure that its processes meet the company's predetermined risk criteria. The PSMS identifies the operational, technical, and cultural barriers necessary to help prevent process safety incidents. Leaders then implement & sustain the PSMS to ensure that all barriers remain effective.



"We make electricity, so it would be easy to think that process safety doesn't apply to us. But we have process hazards like any chemical plant or refinery. Our respect for those hazards and the potential release scenarios is paramount as we develop policy and process. Our deliberate, determined approach to manage process safety is driven by our belief that all accidents are preventable. This in turn drives our passion for process safety excellence."

MARK C. MCCULLOUGH
Executive Vice President, Generation
American Electric Power



(Figure Courtesy of D Guss, Nexen, Inc.)



Sustainable companies are socially responsible. Process Safety plays a leading role.

PROCESS SAFETY helps make a company more attractive to investors, employees, communities, governments, and insurers. Maintaining a strong process safety commitment over time tells critical stakeholders that you care about them and your employees, and that you are managing the company well.

BENEFIT 1 CORPORATE SOCIAL RESPONSIBILITY



“Process safety is a core element to safe, efficient and resilient production. Our global process safety standards provide the framework for the safe construction and operation of our plants and therewith for the protection of people and the environment. So, it is fair to say that process safety essentially contributes to our sustainable business growth and our social responsibility.”

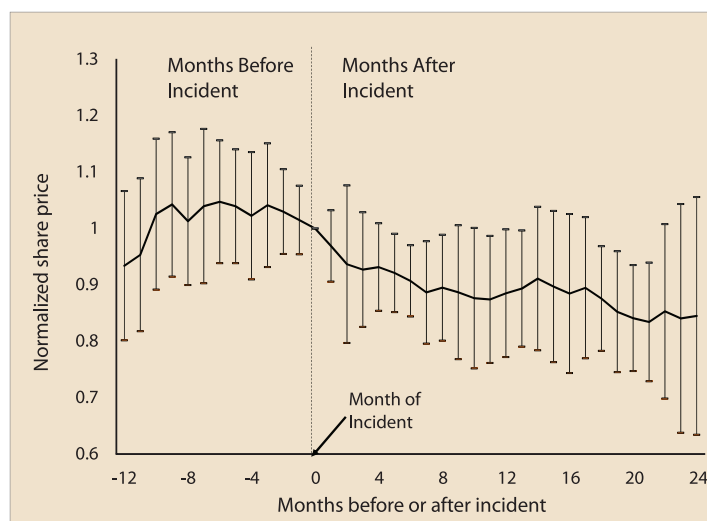
BEATE EHLE
President Environmental Protection,
Health & Safety
BASF

These benefits reflect directly in the primary measurement of a company's valuation – share price. A review of 12 recent major accidents in 4 countries and 4 industry sectors shows the impact of these accidents on share price.¹ In all cases, after accidents, share price immediately begins to drop relative to the market and may continue for a year or more. Following the Bhopal disaster in 1984, Union Carbide's stock dropped continuously relative to the market for 15 years.

The decrease in share price includes losses well beyond the tangible losses alone. The difference, simply put, is shareholder perception. Nearly every stock is priced well above the value of its tangible assets. This premium reflects the confidence of investors in the company's ability to manage, control risk, innovate, and continue to grow sustainably. Practices for showing this premium on balance sheets vary. In some cases, terms such as Intangible Assets or Goodwill reflect all or a portion of this premium.

This shareholder confidence premium is built – or destroyed – by factors directly linked to process safety:

- Actual risk and perceived risk.
- Corporate image.
- Support for the company in the communities in which it operates.
- Employee engagement and attitudes: is the company a preferred place to work?
- Trust in the company from investors, politicians, regulators, activists, and the press.



¹ Incidents occurring in Germany, India, Japan, and USA. Normalized to the applicable country's stock market sector index (chemical, petroleum, pharmaceutical, or utilities, as applicable).

*Share price compared to month-end before incident, normalized by the relevant market index to eliminate gross market trends.

Process safety removes barriers to growth.

COMPANIES that manage process safety effectively earn the flexibility to freely manage their businesses and grow profitably, while satisfying all stakeholders; local communities, the public, regulatory authorities, governments, investors, and customers. Business flexibility results from earning the trust of the public and especially of the local community. It is your company's license to operate. This analogy is complete in the sense that, as with any license, those who award it can also revoke it.

Every incident represents a lost opportunity, because, the company must divert resources to investigation, clean-up, and recovery, as well as legal and regulatory challenges. These resources could otherwise be focused on growth.

Major incidents can also significantly drain available cash. This can force companies to sell valuable assets, often at a fraction of their value - another lost opportunity. Moreover, in many cases it can lead to the loss of the company and the livelihoods of every employee..

Flexibility benefits a company by:

- Allowing managers to focus on growth and productivity, rather than damage control and recovery
- Protecting cash flow from unexpected disruption
- Proving your worthiness to hold a license to operate
- Strengthening and maintaining good relationships with the local community; and
- Helping you obtain approvals for expansion permits or new facilities more quickly – a critical strength when implementing the new projects needed to compete effectively.

A major incident can also weaken a company's ability to respond to competitors' business actions. A company in a weakened state may also become subject to an undesirable takeover.

Additionally, significant incidents can & have lead to new regulations. This impacts the company and everyone throughout the industry.



BENEFIT 2 BUSINESS FLEXIBILITY



"Excellence in process safety enables us to enter markets and manufacture products faster, and it makes us even stronger in terms of reliability, which has been a historical Eastman advantage. As a specialty materials company, speed and reliability are integral to the success of our overall corporate strategy."

DAVID GOLDEN

Senior VP

Chief Legal & Sustainability Officer
Corporate Secretary
Eastman Chemical Company



Process safety helps your company reduce risk and avoid loss.

COMPANIES that have the operational discipline to implement effective process safety programs receive a windfall benefit every year. This gain shows up on the bottom line in the savings from incidents that did not occur.

Some companies may avoid major incidents for a time through luck alone. But even then, the costs of smaller incidents and near misses continue to add up. And luck eventually runs out.

A strong PSMS, coupled with strong process safety leadership, is the only way to sustainably avoid large and small incidents alike. Loss prevention benefits include:

BENEFIT 3 LOSS PREVENTION



“PETRONAS has benefitted greatly from integrating our process safety management

system into our principles of operational excellence in driving business sustainability. We focus on improving operational discipline and asset integrity across the group to prevent major process safety events. Continuous improvements are vital. By leveraging on collaborations with our stakeholders, we can raise the bar of Process Safety Excellence in all that we do.”

DZAFRI SHAM B AHMAD
VP, Group HSSE
Petroliam Nasional Berhad
(PETRONAS)

- **Lives saved and injuries prevented:** Painful personal and financial impacts of human loss
- **Reduced property damage loss:** Major incidents cost an average of \$330 million each²
- **Reduced business interruption loss:** Business interruption losses typically range from 2 – 3 times the property damage loss and can be as much as 11 times greater²
- **Protected market share:** After an incident, market share may be lost, and regained only slowly after production has been restored. Companies that sell direct to consumers may also see market share lost until the company's reputation is restored
- **Reduced fines and litigation costs:** For major incidents, fines can be in the millions of dollars. The costs of lawsuits brought by victims and affected communities can be significantly greater. And in recent years, laws around the world allow senior executives to be tried criminally for serious accidents
- **Reduced regulatory attention:** A major incident usually results in increased regulatory inspections, which can lead to additional fines and tie up resources
- **Reduced remediation costs:** Environmental clean-up costs can be significant and may go on for years

Many of these costs can put a smaller company out of business, due to a significant stress on cash flow. If the company does not have sufficient cash to address the capital and sales losses, it may be forced to sell valuable assets at distressed prices, resulting in a significant loss of shareholder value.

² Marsh, *The 100 Largest Losses 1974-2015*, London, 2016

Process Safety Leadership and Management Systems lead the way to operational excellence.

COMPANIES around the world have learned that when they implement robust process safety management systems, their productivity and quality increase while costs decrease. The reasons should be obvious. Process safety leadership requires you to:

- Understand your process better – normal operation and what can go wrong
- Improve process development and front-end engineering design
- Follow procedures rigorously
- Keep equipment, piping, and controls maintained and in good operational integrity
- Manage change thoroughly
- Stop safely when the process goes out of control, and
- Learn from investigating incidents and near-misses

These can lead to:

- Greater uptime and longer periods between unplanned and planned shut-downs
- Improved yield and productivity; and
- Improved quality and reduced rework

Moreover, participating in cooperative efforts to promote process safety more broadly across the industry also brings real value:

- **Suppliers and customers:** Helping them improve process safety helps assure materials supply and uninterrupted sales for your company
- **Contractors:** Maintaining open communication can help bring in best practices learned elsewhere
- **Standards, guidelines, and regulations:** Helping develop these exposes you to external knowledge and experience, and allows your input to be clearly heard

Embracing process safety as an essential part of the way you do business allows your company to measurably increase revenues and reduce costs. The value created can be substantial. The companies that participated in this study reported financial returns from their investment in process safety from:

- **Increased Productivity and Decreased Downtime:** Due to increased reliability of equipment and risk-based maintenance.
- **Decreased Production Costs:** Due to increased efficiencies.
- **Decreased Maintenance Costs:** Due to improved design and maintenance management.
- **Increased Capital Efficiency:** Due to improved front-end engineering and design to risk criteria.



BENEFIT 4 SUSTAINABLE GROWTH



“At Reliance, safety is both a core value and a priority. As a key element of our group strategic framework it

has been a prerequisite in and enabler of our value creation journey. We are deeply committed to the operating philosophy that safe operation overrides all production targets. It is our firm belief that good Process Safety and Operations Excellence go hand in hand and I am happy that a culture of “safety first” has become deeply ingrained in the DNA of Reliance.”

KV SESHADRI
Group Head – Safety and
Operational Risk
Reliance Industries Limited



Process safety requires – and develops – strong leaders.

COMPANIES increasingly organize their operations management and leadership activities in an integrated management system called, among other names, operational excellence. A closer look at these management systems shows that operational excellence depends on executing the core principles of process safety with dedication and professionalism.

BENEFIT 5 LEADERSHIP EXCELLENCE



“Process safety has been a key element of my personal leadership development and is

now an element of new leader reviews at Arkema. In today’s environment when “safe enough” cannot support a sustainable business model, it’s excellence in leadership that develops resilient organizations to move us to the next level.”

PAUL LEONARD
Vice President HSE
Arkema Group

In an ever more competitive global business environment, companies need visionary leaders who rigorously manage the details. Process safety requires everyone to actively lead, which helps prepare employees for future leadership roles. And since process safety touches so many operational and technical roles, it helps produce an ever-growing cadre of leaders and managers to drive the future of the company.

Just as process safety protects the company against losses from major incidents that can threaten the sustainability of the company, it can also offer protection against other losses – of efficiency, trust, environmental quality, product integrity, and many more.

Process safety role dimension	Leadership skill required and developed
Set meaningful risk reduction targets, communicate, and obtain buy-in	Vision and inspiration
Establish risk criteria and metrics to track progress.	Showing the way
Implement and ensure performance of barriers	Maintaining discipline
Provide needed tools and resources and authority to use them	Empowerment
Show visible support and engage regularly in process safety-related activities	Motivation
Execute role and duties with professionalism. Expect the same of the organization.	Accountability
Appreciate bad news, convert into opportunity for improvement	Walk the talk

PROCESS SAFETY VISION 20/20



VISION 20/20, developed by CCPS, looks into the not-too-distant future to demonstrate what excellence in process safety will look like when it is championed by industry. Vision 20/20 is driven by five tenets and four societal themes.

For more information, including a spreadsheet assessment tool, see <https://www.aiche.org/ccps/resources/vision-2020>.

Tenets

Committed Culture
Vibrant Management Systems
Disciplined Adherence to Standards
Intentional Competency Development
Enhanced Application and Sharing of Lessons Learned

Societal Themes

Enhanced Stakeholder Knowledge
Responsible Collaboration
Harmonization of Standards
Meticulous Verification

For more information, including a spreadsheet assessment tool, see <https://www.aiche.org/ccps/resources/vision 2020>



As the person accountable for drilling and completions at Chevron, I make

well control my primary process safety focus. I must understand and prioritize the process safety risks that exist throughout my organization. I must be familiar with the safeguards in place to mitigate these risks, and I must have a high degree of confidence in the competency of my organization that we have put the necessary critical safeguards in place and manage the details effectively. My dedicated assurance organization works directly for me. This team independently verifies the quality of well design/plan, rig certification and execution which includes critical safeguards at all our drilling locations by Chevron. Process safety must be lived. It can't be only a binder on a shelf.

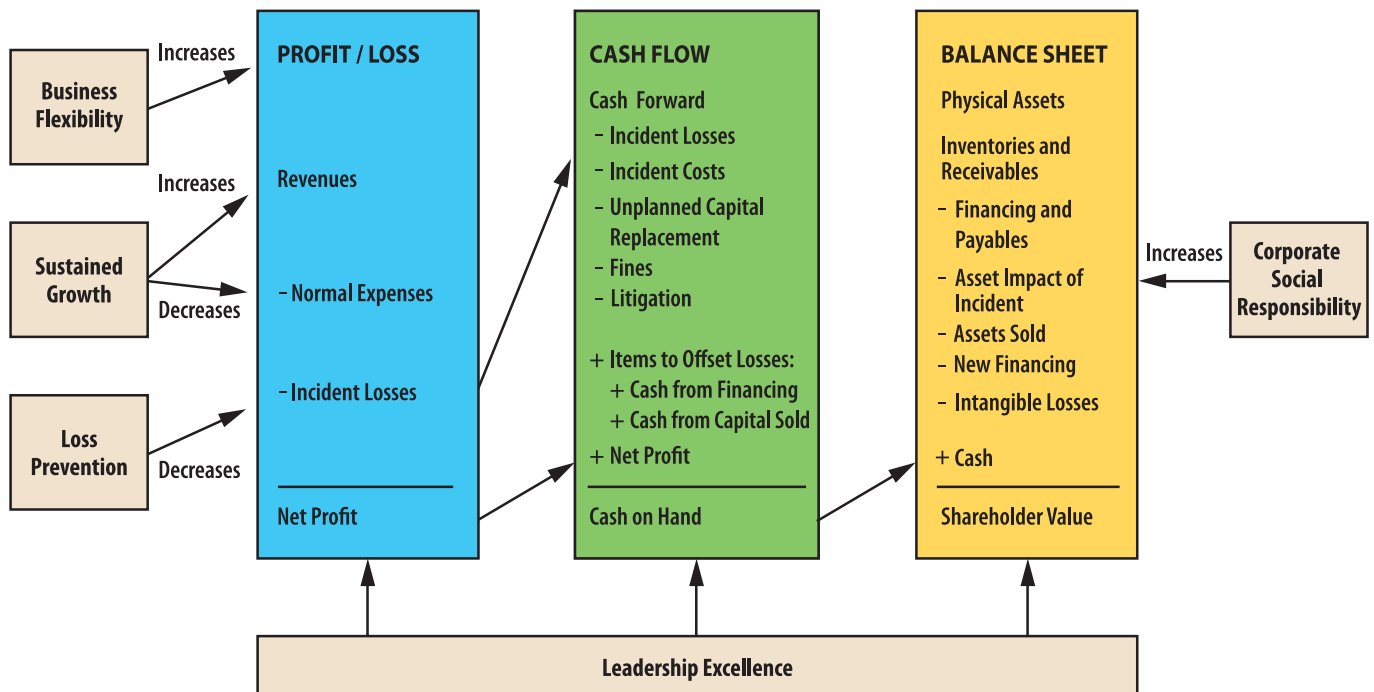
KIMBERLY MCHUGH
Vice President
Drilling & Completions
Chevron

THE BUSINESS CASE FOR PROCESS SAFETY

In summary, the business case for process safety is like the business case for any other aspect of the business. A robust process safety management system operating in a robust culture will enhance your business in five ways, all driving improved profitability and shareholder value:

- Corporate Social Responsibility builds the image of your company, adding to shareholder value through increased goodwill, while helping make your company a preferred place to work..
- Business Flexibility removes barriers to growth and enables your company to focus on innovation and market development.
- Loss Prevention prevents damage to assets and the broader destruction of shareholder value that accompanies incidents.
- Sustainable Growth boosts productivity and quality, while helping to keep your company at the forefront of management systems and technology.
- Leadership Excellence drives leaders to hone their skills and helps develop future leaders.

Influence of the Business Case Elements on Corporate Financial Performance



Realize the Benefits

Nine steps to achieving business excellence through process safety management:

Leadership Action Checklist	Doing ✓
Commit and take accountability among your company's leadership and board of directors.	☐
Establish risk criteria and ensure barriers are implemented and maintained sufficiently to meet these criteria.	☐
Build or close gaps in your process safety management system.	☐
Assign responsibilities at the corporate, business, and facility levels for coordinating and executing the process safety management system.	☐
Build or strengthen a strong process safety culture based on core values and clear performance expectations.	☐
Ensure competency in process safety appropriate to all levels.	☐
Implement goals and lagging and leading metrics to track them to drive performance improvement.	☐
Visit your facilities to reinforce the importance of process safety.	☐
Learn from incidents and near misses.	☐



"At Chemours, we believe it's not enough to consider safety a priority—even a top priority.

The stakes are too high. Safety must be an obsession—something we think about, teach about, and preach about every day. Whether it's process safety or driver safety, safety must come first, everywhere, at all times."

MARK VERGNANO
President and CEO
Chemours Company

This is not a one-time set of activities. To be sustainable, this commitment must also be sustained. Revisit these steps periodically and implement improvements based on lessons learned.

ABOUT THE ARTWORK

Media Description

The artist, Julia Eve Dubin, used watercolor to depict bright, sunny, natural scenes representing safety and health – of workers, the environment and the bottom line. The Business Case for Process Safety should become as natural as these scenes.

Image Descriptions

Corporate Social Responsibility: This image shows a prospering community living in harmony with the plant. When companies collaborate with their employees and their communities, all benefit.



Business Flexibility: A boy is repotting a growing sapling, representing an operating site that wishes to grow, into a larger pot. Its roots now unconstrained, the tree – and the site – can now expand, strengthen, and prosper.



Loss Prevention: This image illustrates preventing the loss of a newly planted tree by staking it up. Following the themes of the previous two images, the company (hardhat) cooperates with the community (no hat) to protect the tree (site).



Sustainable Growth: The tree (the manufacturing site) continues to grow. Having protected the tree in its early years and having removed its barriers to growth, the tree now provides an increasing diversity of opportunity.



Leadership Excellence: Process safety requires everyone to work together cooperatively to reach the top goal of preventing accidents. While not everyone will be at the same place at the same time, everyone plays a critical role.



HELPFUL CCPS RESOURCES

CCPS offers more than a dozen courses and more than 100 books addressing all aspects of process safety. Some resources useful to business, operations, and technical leaders include:

■ **Vision 20/20: A Guiding Vision for Process Safety**

■ **Courses and Workshops**

- CCPS Leadership Workshop
- Process Safety Boot Camp
- Foundations of Process Safety
- Recognizing Catastrophic Incident Warning Signs Workshop

■ **Books**

- Process Safety: From the Boardroom to the Frontline (early 2019)
- Essential Practices for Creating, Strengthening, and Sustaining Process Safety Culture
- Guidelines for Risk Based Process Safety (2007)
- Guidelines for Integrating Management Systems and Metrics to Improve Process Safety Performance (2016)

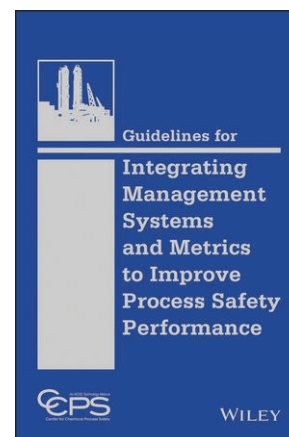
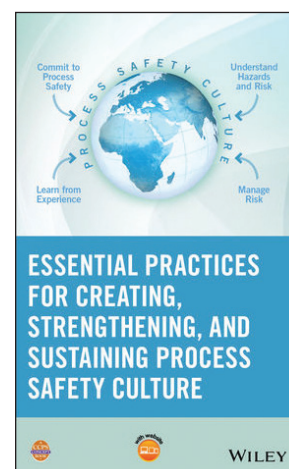
For more information, and a complete listing of courses and books, visit www.ccpsonline.org or call +1.646.495.1371

If your company a CCPS Member?

- You are encouraged to engage and benchmark with fellow members to help each other realize strong process safety programs.
- You are also encouraged to join project teams to help shape future guidelines, another way to bring other companies' experience into your efforts.

If your company not a Member?

- Please contact CCPS@AIChE.org or +1.646.495.1371 for more information

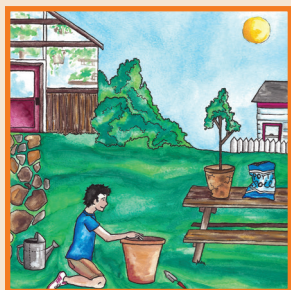


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"Process safety is a core element to safe, efficient and resilient production."

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