



Vol. 44, No. 6 • Nov.-Dec. 2008

In the Spotlight

Download printable
PDF of this page

A Tribute to Trevor Kletz

by David M. Clarke, Derby, U.K.

Pages 1 | 2 | 3 | 4 | 5

Introduction

The work of U.K. safety specialist, writer and teacher Trevor Kletz has been pioneering and influential internationally, including in the United States. The aim of this article is to pay tribute to Kletz's achievements in both industry and academia, provide an insight into the career that supported these accomplishments and further disseminate and publicize his ideas and themes, which offer important routes to improved system safety.



Figure 1 — Trevor Kletz.

Achievements

Trevor Kletz spent his entire industrial career at Imperial Chemicals Industries (ICI), a major U.K. company. During his last 14 years with the organization, from 1968 to 1982, he worked as safety advisor to the petrochemicals division, concentrating on technical accidents, mainly fires and explosions. Figure 2 shows how ICI's fatal accident rate fell during the period Kletz worked in the process safety field. While others were concerned with the same goal, the reduction in the fatal accident rate from the late 1960s onward gives an indication of Kletz's impact and the value of the approaches he used and introduced to his colleagues.

President's Message

From the Editor's
Desk

Outside the Lines

In the Spotlight:

A Tribute to Trevor
Kletz

Making Safety-
Related Decisions

Gains from Losses:

System Safety
Commentary on
Accidents and Other
Events

Special:

26th International
System Safety
Conference:
Innovations and
Legacy

Tech Corner

Chapter News

Mark Your Calendar

About this Journal

Classifieds

Advertising in eJSS

Contact Us

Puzzle



NSWC Federal
Credit Union

Enjoy the
benefits
of
Credit Union
Membership!

Members of the
System Safety
Society
are eligible to join
NSWC Federal
Credit Union

Check us out at
www.nswcfcu.org

Everything we do,
we do for you™

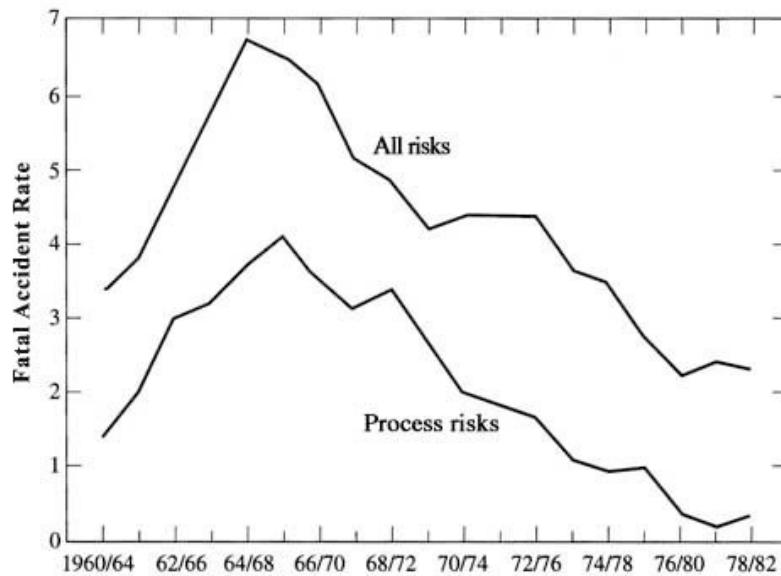


Figure 2 — ICI's Fatal Accident Rate (The Number of Fatal Accidents in 108 Working Hours or in a Group of 1,000 People in a Working Lifetime) Expressed as a Five-Year Moving Average.)

While working in industry and academia, Trevor Kletz contributed to the development and promotion of important new philosophies and techniques in process safety, including inherently safer design, HAZOP, HAZAN and prevention of accidents associated with human error. Known as an effective communicator, he has published 11 books, more than 100 peer-reviewed papers and a great many short pieces on loss prevention and process safety. His best-selling book, *What Went Wrong* [Ref. 1], currently in its fourth edition with a fifth in preparation, has sold more than 20,000 copies. In it, numerous accident case histories are examined to determine what went wrong, why it went wrong, and how similar tragedies could be prevented. Kletz has lectured at a large number of organizations around the world. In the U.K., he is a Fellow of the Royal Academy of Engineering, the Institution of Chemical Engineers and the Royal Society of Chemistry. In the U.S., he is a Fellow of the American Institute of Chemical Engineers. He is the recipient of several awards and honors by industry and academia. In 1997, he was appointed an officer of the Order of the British Empire (OBE) for achievement and exceptional service in the United Kingdom.

[next page »](#)



Vol. 44, No. 6 • Nov.-Dec. 2008

In the Spotlight

A Tribute to Trevor Kletz

by David M. Clarke, Derby, U.K.

Pages 1 | 2 | 3 | 4 | 5

Professional Biography

Kletz joined ICI in 1944. His first eight years were spent in research and the next 16 in a variety of managerial positions, including as an assistant works manager in the ICI heavy organic chemicals (later petrochemicals) division [Ref. 2].

In 1968, Kletz took up a newly created post as safety advisor with responsibility for process safety and began the work for which he is best known. In this new role, he developed a technology-driven and incident-driven approach with which he could identify the technical causes of adverse events and suggest measures to prevent them from happening again. Kletz believed that people would be more likely to follow his advice if they understood the rationale behind it. Consequently, he relied not on authority, but rather on the force of his arguments to persuade people to follow safe practices.

To help get his ideas across further, Kletz started a monthly *Safety Newsletter*, consisting mainly of reports on accidents within ICI and other companies. The first issue in 1968 was sent to about 30 people, but by 1982 its circulation had increased to several thousand, including all ICI divisions, many outside companies, universities and the U.K. Health and Safety Executive. The U.K. Institution of Chemical Engineers has recently posted the first hundred issues on the Internet (www.icheme.org) and will be adding the remaining 71 in the future.

Another Kletz initiative was the instigation of regular group discussions of accidents and the lessons that could be drawn from them. The specific topics addressed at these meetings included:

1. Accidents due to human error
2. Organizational memory
3. Accidents due to over-pressuring of vessels
4. Accidents due to instrument failure
5. Inherently safer plants
6. Lessons of the disasters at Flixborough and Three-Mile Island

In his later years at ICI, Kletz formed an association with Loughborough University in the U.K. After retiring from industry in 1982, he joined the university and began a second career. His work at this time was influenced by the major accidents of the period, including Bhopal, Chernobyl and Piper Alpha. After five years at Loughborough, Kletz became a freelance consultant and writer, but maintained a link with the university. He is currently a visiting professor at Loughborough and an adjunct professor at Texas A&M University in the U.S. Kletz's work in academia has been built upon the foundation of the knowledge and experience gained during his industrial career.

Kletz's main interests in process safety — and what prompted them — are summarized in Table 1.

Table 1 — Kletz's main interests in process safety and what triggered them (adapted from Ref. 2, PFV Publications, with permission of Trevor Kletz).

HAZOP	The obvious need to find out what can go wrong before it happens
-------	--

“ Kletz believed that people would be more likely to follow his advice if they understood the rationale behind it. Consequently, he relied not on authority, but rather on the force of his arguments to persuade people to follow safe practices. ”

When Safety Is Critical

Achieve Your Safety Objectives with Relex®



Reduce or eliminate potential hazards before they cause harm.

Relex risk assessment tools help you manage and measure risk throughout your product lifecycle.

- Fault Tree
- FMEA/FMECA
- Markov Analysis
- Human Factors Risk Analysis
- FRACAS

Ensure product safety!

Learn how to reduce risk using Relex. Download our free trial version at safety.relex.com. Or, let us personally introduce you to Relex. Give us a call today at 724.836.8800.



HAZAN (QRA)	The need for a defensible approach to setting priorities when dealing with hazards
Inherently safer design	The disasters at Flixborough (and later Bhopal) showed what should have been obvious: Removal of a hazard is preferable to control of the hazard
Preparation for maintenance	A fire at ICI in 1967 showed that safety advisors should have experience with technology and its preparation for repair
Control of modifications	The Flixborough disaster (and other less serious accidents)
The new attitude toward human error	The realization that most accidents could be prevented or made less likely by managers' actions
Better investigations of accidents	The realization that many accident investigations focus only on immediate causes and not on ways of avoiding the hazard or weaknesses in management
Better publicity for accident reports	Four reasons: a) moral, b) so that others will tell us about their accidents, c) so that they will make the changes we make, and d) because in the eyes of the public the industry is one
Better ways of remembering the lessons of the past	Both major and minor accidents are repeated after a few years, even in the same organization
Audits and inspections	Outsiders can detect hazards that insiders miss
Myths of the chemical industry	Beliefs that are not wholly true can be widely accepted and result in accidents [Ref. 3]
Accident case histories	The realization that a) case histories grab attention and b) people can disagree with advice offered to them, but can hardly ignore the accidents. We should start talks and discussions with reports on accidents and draw lessons from them.

[« previous page](#) | [next page »](#)

philosophy, the removal of hazards is achieved through:

- **Intensification:** Use small amounts of hazardous materials (a smaller inventory) so the consequences of accidents arising from escape of materials are much reduced.
- **Substitution:** Use a less hazardous material — less flammable or less toxic.
- **Attenuation:** If a hazardous material must be used, use it a) under less hazardous conditions or b) in the least hazardous form.
- **Limitation of effects:** Limit the effects of failures by changing the design or conditions of use rather than by adding protective equipment that may fail or be neglected.

Using an approach from management thinking, Kletz has represented the first three principles of inherently safer design in the form of simple images (Figure 4). The pictures are intended to convey the principles and should not be interpreted as diagrams.

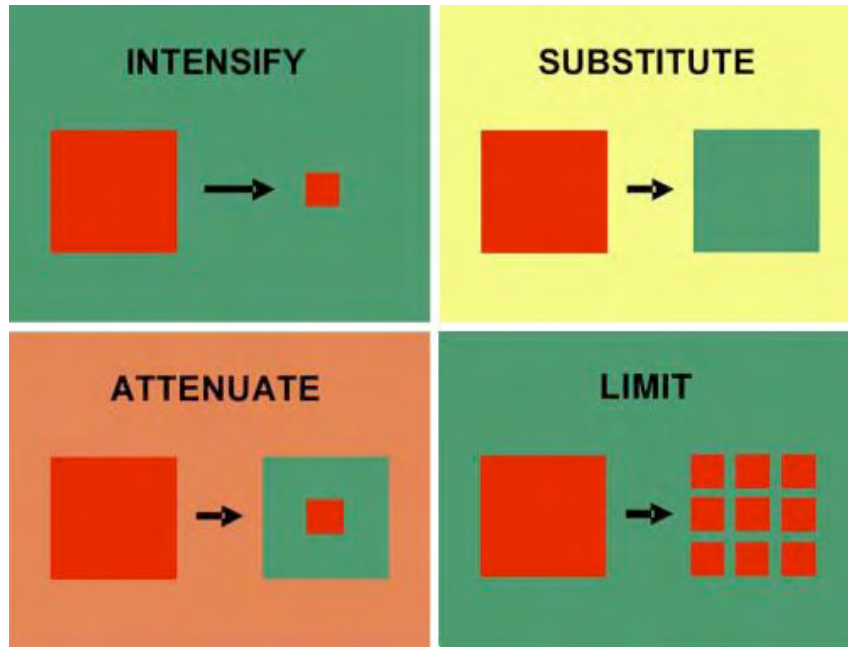


Figure 4 — Kletz's Visual Representations of Principles of Inherently Safer Design (adapted with permission of the Institution of Chemical Engineers).

While the full possibilities and applications of inherently safer design take time to appreciate, the basic message and the high-level principles listed above are readily comprehensible. However, such approaches were not being used before Flixborough, and it has taken decades to firmly establish them as recognized design principles. There is still a need for increased awareness in some parts of industry, particularly among design engineers and management. This situation is the result of several barriers to the application of inherently safer design and innovation in general. One important barrier is that new approaches require time for development, while old designs with a few improvements can be completed more quickly.

An associated approach advocated by Kletz is "friendly plant design." To illustrate, systems are friendlier if designs are made simpler, there is tolerance of mal-operation and response to change is flat and slow, rather than rapid and steep.

[« previous page](#) | [next page »](#)



Vol. 44, No. 6 • Nov.-Dec. 2008

In the Spotlight

A Tribute to Trevor Kletz

by David M. Clarke, Derby, U.K.

Pages 1 | 2 | 3 | 4 | 5

Human Error

In the past, investigation of accidents often stopped when evidence of human error was found. A reminder or some form of disciplinary action was seen as the appropriate way of preventing similar occurrences from happening in the future. This pattern of response to a mishap in industry is still not uncommon today. Kletz, however, encapsulates his approach to human error with the advice: "Try to change situations, not people." His view is that accidents that may appear to be due to human error can be prevented, or made less likely, by changing the plant design or methods of operation.

Kletz classifies errors in a way designed to help find the most effective way of preventing accidents [Ref. 6]:

- Errors due to a slip or momentary lapse of attention
- Errors due to poor training or instructions
- Errors that occur because a task is beyond the physical or mental ability of the person asked to do it
- Errors due to a deliberate decision not to follow instructions or accepted practice (sometimes called violations or non-compliance)

In a complementary approach, Kletz also addresses human error by activity, including errors during:

- Design
- Construction
- Maintenance
- Methods of operation

For each category, Kletz proceeds by describing accidents in which such errors were implicated and identifying countermeasures that prevent the accident or make it less likely. Examples of his many suggestions to reduce error include:

- Making incorrect assembly impossible
- Simplifying jobs to reduce opportunities for error
- Improving interface design (such as displays)
- Advising managers on how they can support the reliability of the people who work for them

Organizational Memory

Following a fire at ICI in the 1960s, Kletz found an old accident report describing a similar incident 30 years earlier. The report contained similar recommendations to those made in the 1960s. This was a prime example of lessons from the past being forgotten and an accident recurring. According to Kletz, such events occur because people move on, whether through job changes or retirement, and take their memories with them. He has coined the phrase "Organizations have no memory," and suggests several ways of retaining the lessons of the past [Ref. 7], including:

- Put in every code, standard and instruction a note on the reason for it, thereby highlighting, explaining and clarifying the benefit to safety. As a result, it will be less likely that the rationale for changes will be forgotten and perhaps reversed.
- Use safety bulletins and safety reports to remind people of old accidents, as well as recent ones.
- Hold regular training sessions in which old accidents are discussed (and ask people how they would prevent them, which is more effective than simply telling them).
- Improve information retrieval systems.

« previous page | next page »

President's Message

From the Editor's Desk

Outside the Lines

In the Spotlight:

A Tribute to Trevor Kletz

Making Safety-Related Decisions

Gains from Losses:

System Safety Commentary on Accidents and Other Events

Special:

26th International System Safety Conference: Innovations and Legacy

Tech Corner

Chapter News

Mark Your Calendar

About this Journal

Classifieds

Advertising in eJSS

Contact Us

Puzzle

Putting the Pieces of Reliability, Availability, Maintainability, Safety and Quality Assurance TOGETHER!



item
software

Visit our Web site at
www.itemsoft.com
to Learn More About
Our New Analysis
Modules!

714-935-2900 U.S.
+44 (0) 1489 885085 U.K.

Home

Subscriptions & Memberships

Contact

About eJSS

System Safety Society


Vol. 44, No. 6 • Nov.-Dec. 2008

In the Spotlight

A Tribute to Trevor Kletz

by David M. Clarke, Derby, U.K.

Pages 1 | 2 | 3 | 4 | 5

Conclusion

Trevor Kletz made a central contribution to the sharp reduction in accidents achieved at ICI during his years employed there. Through a technology-driven and incident-driven approach, he was able to identify the technical causes of adverse events and to suggest measures to prevent them from happening again. He achieved results by persuading people through argument that certain ways of working and the use of certain philosophies and techniques would lead to safety benefits. Within his organization, he was effective at publicizing his findings and recommendations.

While working in industry and academia, Kletz has made contributions to the development and promotion of important new approaches in process safety. One of the ways he has accomplished this is by making constructive responses to accidents and perceived weaknesses in existing methods (as summarized in Table 1). With the help of his considerable communication skills, his technical messages have reached a wide audience.

Of Kletz's themes, some have been readily taken up by the safety community. Others require more attention from industry, including inherently safer design, human error and organizational memory.

Note

The *Safety Newsletters*, issues 1-100, are available for free download at www.icheme.org. Follow links "Safety," "Safety Newsletters," "More Details..." and "Safety Newsletters 1-100," and complete the online order process (including registration). The Institution of Chemical Engineers will send an email containing a link for download.

Disclaimer

The views expressed in this article are those of the author.

References

1. Kletz, T.A. *What Went Wrong? Case Studies of Process Plant Disasters*, 4th Edition, Butterworth-Heinemann, Oxford, 1998.
2. Kletz, T.A. *By Accident: A Life Preventing Them in Industry*, PFV Publications, London, 2000.
3. Kletz, T.A. *Dispelling Chemical Engineering Myths*, 3rd Edition, Taylor and Francis, London, 1996.
4. Kletz, T.A. "What You Don't Have Can't Leak," *Chemistry and Industry*, Vol. 6, May 6, 1978, pp. 287-292.
5. Kletz, T.A. *Process Plants: A Handbook for Inherently Safer Design*, 2nd Edition, Taylor & Francis, Philadelphia, PA, 1998.
6. Kletz, T.A. *An Engineer's View of Human Error*, 3rd Edition, Institution of Chemical Engineers, Rugby, 2001.
7. Kletz, T.A. *Lessons from Disaster: How Organizations Have No Memory and Accidents Recur*, Institution of Chemical Engineers, Rugby, 1993.

About the Author

After working at a research institute in London, David Clarke joined Rolls-Royce as an electrical design engineer. He then moved into probabilistic safety assessment and pursued interests in safety management more widely. For many years, he has been involved in human reliability assessment, with recent work including the collection and analysis of human performance data using full-scope, high-fidelity training simulators. He has more than 20 years of experience in the field of system safety and is the author of several published papers on human reliability, safety and quality.



27th International System Safety Conference

 Aug. 3-7, 2009
Huntsville, Alabama

Call For Papers

Jan 31	Peer Review Paper Submission
Feb 28	Acceptance Notification
May 16	Peer Review Paper Presentation Slides
Jan 16	Forum Paper Abstract Submission
Feb 16	Acceptance Notification
Mar 16	Forum Paper Submission (draft)
April 16	Forum Paper Submission (final) w/ Publication Release Form
May 16	Paper Presentation Slides (draft)
June 16	Paper Presentation Slides (Final)
Mar 31	Tutorial/Workshop Abstract Submission
June 1	Paper Presentation Slides (Final)

For more information
about the conference
and submissions, visit
www.issc2009.org

President's Message

From the Editor's
Desk

Outside the Lines

In the Spotlight:

A Tribute to Trevor
KletzMaking Safety-
Related Decisions

Gains from Losses:

System Safety
Commentary on
Accidents and Other
Events

Special:

26th International
System Safety
Conference:
Innovations and
Legacy

Tech Corner

Chapter News

Mark Your Calendar

About this Journal

Classifieds

Advertising in eJSS

Contact Us

Puzzle