

## The Gamification of Process Safety

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Process Safety is important. But it is often also communicated in a dull, pedantic, overbearing way. Can we use gamification to engender captivation and enthusiasm amongst front line workers, benefiting all of us in the process?

The paper will describe the key tenets of gamification, state where the author feels Process Safety is early in the 21<sup>st</sup> century, discuss the benefits and pitfalls of a gamification approach, offer some examples of how gamification has worked in business, posit why the time for Process Safety Gamification is now and offer some examples of how this can be achieved.

### Introduction

Yu-kai Chou, is an authority on Gamification and Behavioural Design. He developed a Gamification Framework, Octalysis [Ref 1], after more than 10 years of Gamification research and study. In an excellent TED talk, Mr Chou described the 8 gamification tenets which can be applied to an activity to make it more captivating are: Meaning, Accomplishment, Empowerment, Ownership, Social Influence, Scarcity, Unpredictability, Avoidance. Fleshing them out, with a possible PS twist, they are:

- **Epic Meaning and Calling** – *participants feel that their PS mission is critical and larger than themselves alone.*
- **Development and Accomplishment** – *generate short term gratification (e.g. milestone celebration) to encourage participants to endeavour with activity.*
- **Empowerment of Creativity and Feedback** – *iterative and evolving mini-task combined with feedback*
- **Ownership and Possession** – *Perhaps by creating a character which needs to be protected from PS incidents*
- **Social Influence and Relatedness** – *Compare and contrast with the performance of other front line teams. Create a PS league table.*
- **Scarcity and Impatience** – *Put goals just out of reach so they become tantalising*
- **Unpredictability and Curiosity** – *Randomly select and notify participants for a monthly PS lottery when a PS task is completed*
- **Loss and Avoidance** – *Engender a sense of potential loss to the character, or perhaps the participants family if they are injured/killed.*

### Where is PS in the Early 21st Century?

Production and Processing installations are among the safest work places in the world (US 2013: Chemical Manufacturing Industry - 18; Mining - 154, Source USBLS [Ref 2]). This has been achieved, in large part, thanks to a thorough and largely conventional approach to Process Safety. However, when things go wrong, they can do so in a big way: Piper Alpha, Deepwater Horizon, Texas City, Flixborough and Bhopal are significant examples

Figure 1 below would seem to demonstrate that Process Safety has improved significantly over the recent past but appears to have plateaued.

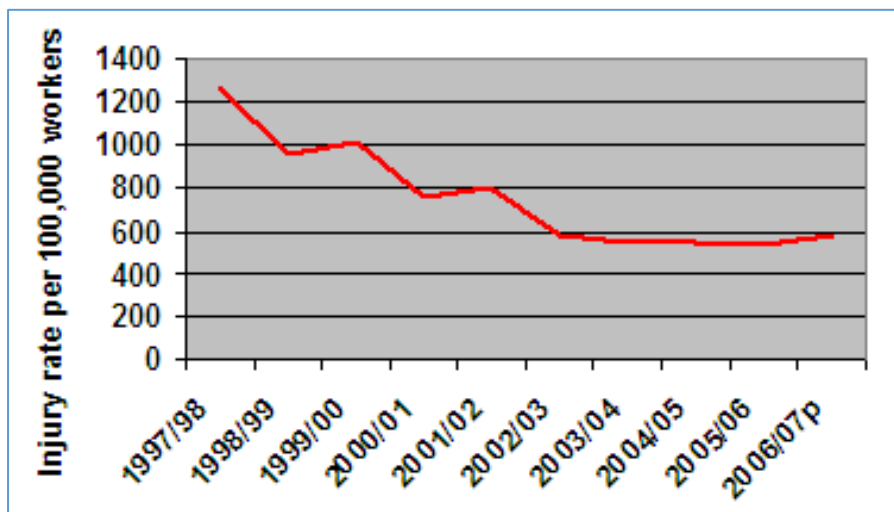


Figure 1: HSE Statistics on Injury Rates in UK Offshore Sector

However, figure 2 below indicate that the risk of worker fatality among oil industry workers is still significant.

Figure 2: US Department of Labour Workplace Fire/Explosion Fatality Statistics



It may be that we have come as far as we can in terms of eliminating engineering causes. What remains are primarily due to human factors. Indeed, the IChemE has recognized and targeted with its Human Factors in Health and Safety modular training course [Ref 9], jointly developed with the Keil Centre which focuses on how a better understanding of how to manage human factors can drive safety standards and overall business performance.

As Process Safety is a serious subject, which, if poorly executed can have serious outcomes. Hence, conventionally, we generally adopt a serious approach and tone when encouraging good PS behaviour. By focusing earnestly and perhaps exclusively on catastrophic but extremely infrequent outcomes (Piper Alpha, Texas City etc), This can lead to discomfort and avoidance.

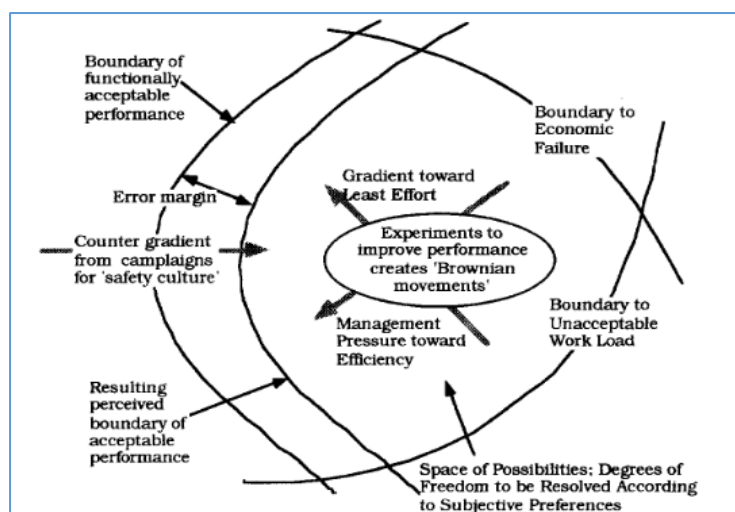
Daniel Kahneman observed in his book, *Thinking Fast and Slow* [Ref 3], an irrational fear when he stopped at traffic lights in Tel Aviv by a bus following a spate of bus bombings in the city. As a psychological researcher, he knew that the chances of the adjacent bus blowing up when he was next to it were vanishingly small, nevertheless his awareness of that proximity triggered thoughts of bombing and generated an urge to distance himself from the bus and the threat. In the same way, the more we think about Process Safety, the more likely we are to be drawn into feeling uncomfortable about Process Incidents, thus leading to a psychological rejection of the whole field. We want to tip the bath water out and the baby inevitably departs as well.

### Which organisations are vulnerable to PS incidents?

Many organisations are vulnerable to Process Safety incidents (really any one when a hazard is contained). This risk is influenced by a number of psychological forces.

Three of those forces are referenced in a 1997 paper [Ref 4], published in the *Journal Safety Science*, where Jens Rasmussen argues that in the presence of strong cultural and psychological forces (Corporate, Safety, Individual) human behaviour are likely to migrate towards the boundary of acceptable performance.

Figure 3: Jens Rasmussen Organisational Risk Model



He argued that Experiments to improve performance creates 'Brownian movements' and that individual and corporate drivers will push the operations envelope towards the perceived boundaries of acceptable performance.

Additional forces include Company Reputation, Employee Wellbeing, Security, Occupational Health & Safety and the Environment. As these forces are independent and drive behaviour distinctly, there is a significant risk that PS gets obscured:

Figure 4/5/6: The Obscuring of the Process Safety Tenet



I believe that gamification is a tool which can help us achieve this.

## Before we go further – Some Definitions

I think it is useful at this stage to make some context specific definitions. According to Dictionary.com, **Work** is an activity involving mental or physical effort done in order to achieve a result, while **Play** is to engage in activity for enjoyment and recreation rather than a serious or practical purpose. It is therefore unsurprising that one antonym of **Play** is **Work**. However, play theorist Brian Sutton Smith, suggests ‘The opposite of play is not work but depression’ [Ref 5].

Furthermore, **Gamification** is defined by Wikipedia as ‘the application of game-design elements and game principles in non-game contexts. Gamification commonly employs game design elements which are used in non-game contexts to improve user engagement, organizational productivity, flow, learning, crowdsourcing, employee recruitment and evaluation, ease of use, usefulness of systems, physical exercise, traffic violations, voter apathy, and more.’ It goes on to state ‘a collection of research on gamification shows that a majority of studies on gamification find it has positive effects on individuals.’

## Gamification in Real Life – My Life

In researching and developing this article, I wondered if I applied any gamification to improve aspects of my own life. The example that stands out is car driving. I am a frequent driver, alternating between short social and longer business trips. I have found driving to be a chore, especially long journeys. I realised that, I unconsciously used gamification to increase my enjoyment and therefore attention by, for example – gliding down hills in neutral; looking out for speed cameras to beat them by driving below limit when passing them; applying small speed surge to unsettle tailgaters; exact pump filling (not always successful)

Figure 7: Angus Keddie’s Tank Filling Game (Doh! Lost Again)



## Benefits and Pitfalls

According to an article entitled ‘The Pros And Cons Of A Gamified Work Culture Article’ by Nir Eyal and Stuart Luman [Ref 8], we should recognize the benefits that gamification can bring, while being wary of some of the down sides.

In no particular order, the Good are:

### 1. Gamification Increases Employee Engagement

In a Gallup Employment Engagement Survey 2013 [Ref 6], it was found that

- 13% Engaged – committed to the goals of the org
- 63% Not Engaged - unmotivated
- 24% Actively Disengaged – unhappy, liable to spread negativity

Gamification can help to raise these chronically low figures.

### 2. Gamification Offers Immediate Signs of Achievement and Progress

In the gamified workplace, employees receive constant updates on their performance as they earn higher rankings and badges that get the attention of colleagues and supervisors. Companies like Spotify and LivingSocial have already replaced traditional reviews with mobile and gamified versions and have reported that 90% of employees are voluntarily participating in the programs.

### 3. Gamification Allows the Best And Brightest To Shine

A vital benefit of gamifying business is that it helps companies identify their future stars and leaders. Rather than just motivating the disengaged, gamification provides tools for motivated workers to contribute and be recognized. Unlike in the past, when managers would call attention to their best employees, workers now identify each other. NTT Data and Deloitte use gamification to provide their employees with the chance to learn about leadership roles, develop management skills, and become better known within their organizations based upon their gameplay.

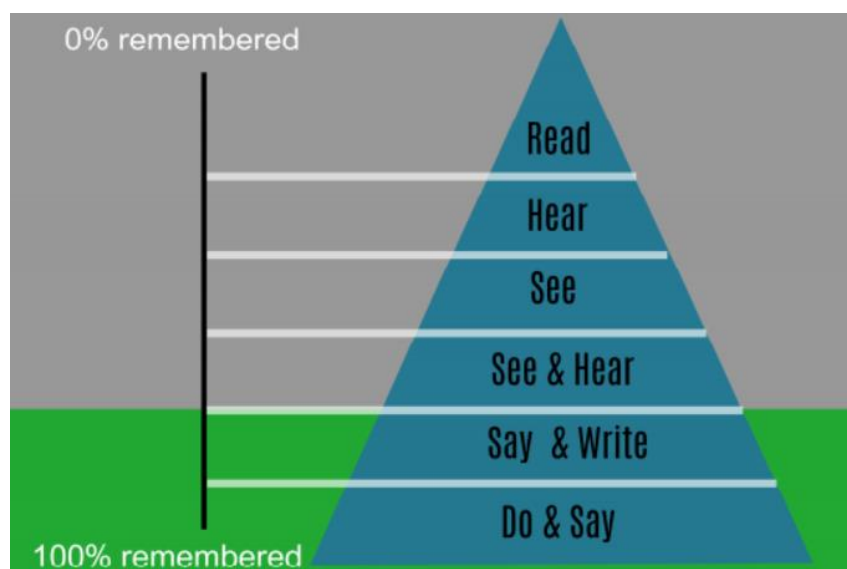
### 4. Gamification Is a New Type Of Credential

German enterprise software company SAP has used a point system to rank top contributors on its SAP Community Network (SCN) for a decade. Users of the social media site earn points when they contribute to forums and when their posts are liked. Rankings are visible on a global leaderboard, which is then used in employee performance reviews and when managers are searching for domain specialists when forming project teams.

### 5. Gamification helps optimize critical information retention

One of the main benefit of gaming, for me, is the increased retention of information through active rather than participation. There is disagreement about the percentages but no disagreement that an active approach is better for retention. See the attached cone of experience based on Edgar Dale.

Figure 8: Edgar Dale's Cone of Experience [Ref 7]



The Bad – which we need to acknowledge and, if necessary, mitigate:

#### 1. Gamification Is Often Ham-fisted

Many companies implementing enterprise gamification do so in the most generic ways. They slap point systems, badges, and leaderboards onto any work process they can think of rather than creating thoughtful experiences that balance competition and collaboration. They overlook the importance of creating meaning and fun in employees' lives.

#### 2. Mandated Play Isn't Really Play

Wall Street Journal technology reporter Farhad Manjoo questions any attempt to gamify work, musing that employees will rebel en masse when corporate managers try to make otherwise mundane jobs "fun." Furthermore, gaming evangelist and Reality Is Broken author Jane McGonigal, who has distanced herself from gamification, insists that games by their nature must be voluntary. When a company insists its employees play along, it stops being a game and is a form of coercion.

#### 3. Gamification Is an Invitation to Cheat and Stab Coworkers In the Back

For as long as people have played games, they've cheated at them, too. When people's jobs, promotions, and raises are based on a game, the temptation to cheat or take advantage of loopholes in the system can be hard to resist. Even worse, efforts to increase internal competition could provoke employees to actively sabotage each other or make unethical choices rather than work together for the good of the company as they attempt to hit specific goals. A quick search of SAP's Community Network reveals many allegations by users of others cheating to increase their site rankings.

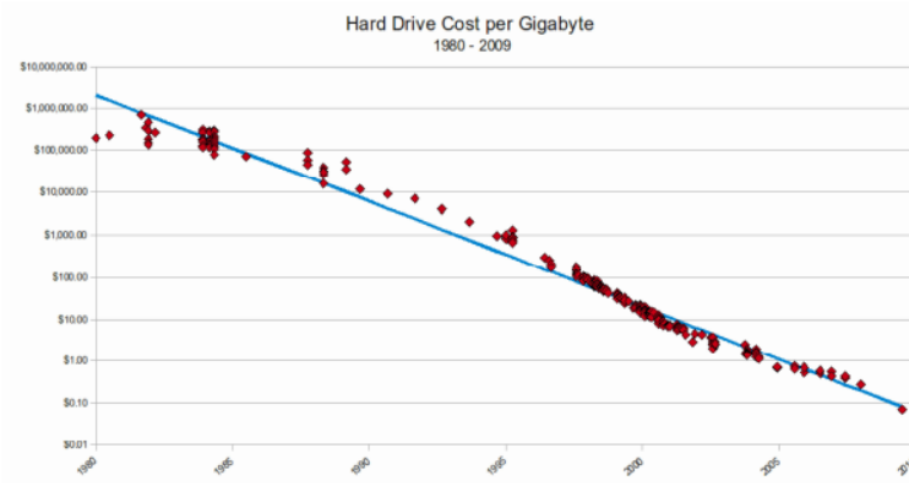
#### 4. The Novelty Wears Off

At some point, most games get tiresome. Remember FarmVille? A challenge for enterprise gamification designers will be engineering variety and novelty into the experience to keep it novel. Workers may tire of badges, leaderboards, and challenges designed to keep them motivated in jobs that they otherwise wouldn't want to do. Gamification might offer short-term productivity gains rather than long-term benefits.

#### Price Plummeting

There are other good reasons to judge that the time to apply gamification to significant but under-appreciated workplace activities such as Process Safety is now. Over the past 50 years, the validation of Moore's Law (the observation that the number of transistors in a dense integrated circuit doubles approximately every two years) has meant that interactive, real time soft and hardware has become commercially viable in the 2<sup>nd</sup> decade of the 21<sup>st</sup> century. Figure 9 below shows the fall in price of Data Storage provision over past 30 years.

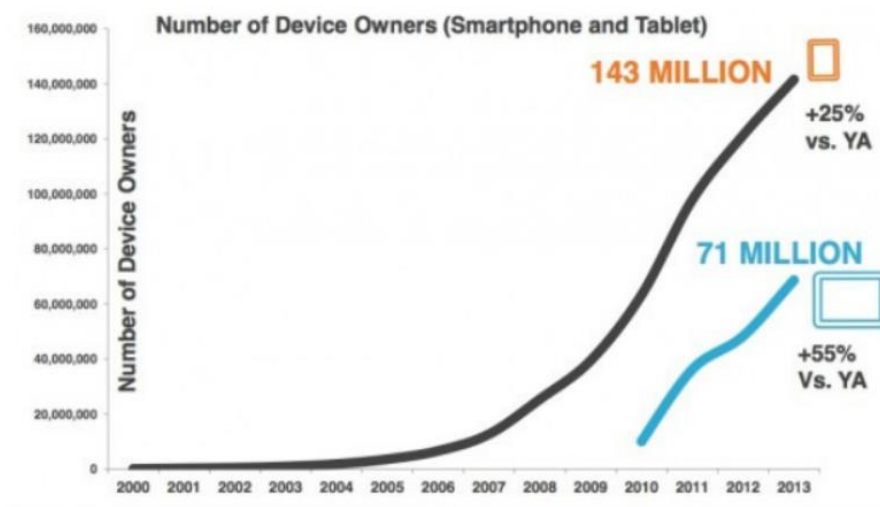
Figure 9: Fall in Data Storage Cost from 1980 to 2009



#### Workforce Assimilation

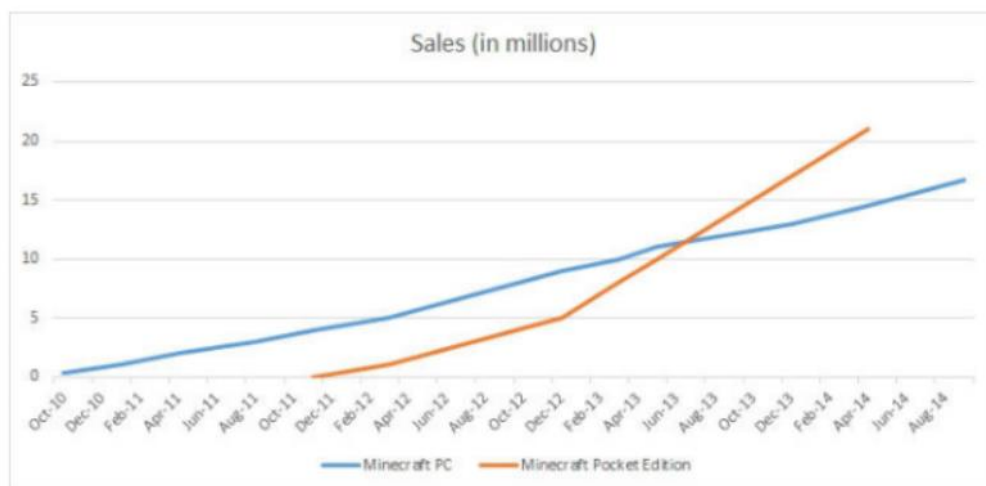
Furthermore, the usage and familiarity of smart phones and tablets has exploded over the past 10 years.

Figure 10: Usage of Smart Phones and Tablets since 2000



Finally (and probably not co-incidentally) there has been a massive recent increase in participation for online virtual competitive games such as Minecraft. This means that site workers are becoming comfortable with and enthusiastic about computer based games.

Figure 11: Minecraft Sales 2010 to 2014



## Reference Success Stories

So how have leaders in other organisational sectors leveraged gamification for their benefit. Two examples are US Retail Giant Walmart and the Department of Work and Pensions (DWP), which is a branch of the UK Government.

- Walmart,

With the objective of providing safety training for 5,000 associates in eight distribution centres, Walmart started to use gamification. Although delivered in just three-minute gamified applications, this training proved highly addictive and very effective.

Not only did employees start talking about their leaderboard rankings, they also discussed the importance of adhering to safety protocols. As a result, there was a 54 per cent decrease in incidents among Walmart's participating distribution centres.

- Department of Work and Pensions,

A branch of the UK government, the DWP started to use gamification as a result of the desire to decentralise innovation within the organisation. The method was Idea Street, an online ideas-management platform and game that encouraged employees to share their best ideas.

Previous efforts to engage employees were unsuccessful, but Idea Street had around 4,000 users within the first 18 months of its launch and it is said to have generated 1,400 ideas in the same period, 63 of which have been implemented by the organisation.

- Considerate Constructors Scheme (CCS)

In 2011, the UK based CCS launched a scheme which used gamification to warn children of the dangers of playing in construction sites. One of the communication vehicles was a 'Hunt the Hazard' game [Ref 10], printed on a poster, located at site entrances:



Figure 12: Hunt the Hazard Site Poster



### PS Gamification: So if now, how?

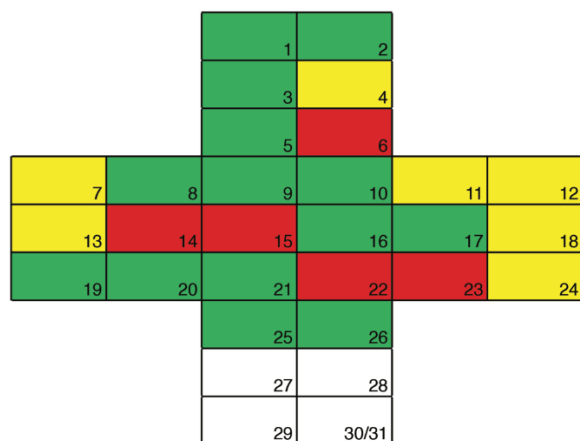
So how can we apply the Octalysis tenets in a Process Safety Context. The following are **ideas** and **target audiences** for consideration:

Octalysis Tenet	Description	PS Gamification Idea	Potential Participants
Epic Meaning and Calling	Participants feel that their PS mission is critical and larger than themselves alone	Computer Based Training (CBT) PS game with goal of keeping the hazard monster inside the pipe	Operators/FL Supervisors
Development and Accomplishment	Generate short term gratification (e.g. milestone celebration) to encourage participants to endeavour with activity	Creating an animation of incident employee has prevented by intervention	Operators/FL Supervisors
Empowerment of Creativity and Feedback	Iterative and evolving mini-task combined with feedback	Macdermid Safety Cross program*	Operators/FL Supervisors
Ownership and Possession	Perhaps by creating a character which needs to be protected from PS incidents	CBT PS game with goal of keeping the hazard monster inside the pipe	Non-operating managers
Social Influence and Relatedness	Compare and contrast with the performance of other front line teams. Create a PS league table	3 monthly updates of where company sits of average and best of peers	Directors
Scarcity and Impatience	Put goals just out of reach so they become tantalising	Setting and celebrating PS milestones (leading indicators etc)	Operators/FL Supervisors



Unpredictability and Curiosity	Randomly select and notify participants for a monthly PS lottery when a PS task is completed	Operating site Speedcam lottery**	All
Loss and Avoidance	Engender a sense of potential loss to the character, or perhaps the participants family if they are injured/killed	CBT PS game with goal of keeping the hazard monster inside the pipe	PS specialist

\*A Safety Cross (used by Macdermid at their factory in Wantage, UK) is a prominently displayed cross with spaces for each day of the month (or week of the year) which is colour coded to indicate incident, no incident, action to avoid incident



\*\* Fines generated by employees speeding on site are used to provide lottery prizes for all those that don't speed

### PS Gamification – Current Examples

#### 1. 'Fill It Up'

A recent example of using gamification to improve process safety knowledge is a game called 'Fill It Up' developed by Caspian Psychology Ltd and delivered offshore by IHF Ltd.

The learning objectives for this game are to increase awareness of barrier management, in particular knowledge about the different ways barriers can be weakened and be strengthened. The game involves teams competing against each other on a digital game where they have to process 8 cylinders of phosgene in the quickest time. The teams are introduced to 'bow-tie analysis' and make choices (which cost added time) about how they can strengthen barriers and prevent releases of gas. The choices are fed into the game and the process is impacted by their choices (e.g. a bigger time penalty if alarms are not maintained). The teams react to the feedback they are given during the race and the team that identifies weaknesses and take action to maintain barriers up-front are at a big advantage. The game uses several of the Octalysis tenets of gamification to create engagement, in particular social influence, meaning, empowerment, accomplishment, loss avoidance and curiosity.



Figure 13: Front line workers playing 'Fill It Up'


## 2. PSM CBT

Another example is the computer based PSM Fundamentals Training Course, developed by my own company Process Safety Matters. The program combines powerpoint slides, videos and Turning Point polling applying a modular approach to enables trainees to learn at their own time and pace. Octalysis tenets of Accomplishment, Relatedness and Feedback are engendered by judicious use of multiple choice questions, immediate answers and peer comparison.

Figure 14: An image from PSM Fundamentals Training Course CBT

Which of the below is an example of or a causal factor for a violation?

1. Equipment configuration and layout
2. Employees rushing towards incident
- ✓ 3. Locating Emergency Air Supply near Reactor Safety Valve
4. Operator turning wrong way at base of stairs
- ✓ 5. Operator bypassing Reactor Safety Valve



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