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Do you Speak Procurement?

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Knowledge and competency has been defined as one of the six pillars of process safety by the IChemE Safety Centre (ISC). It is fundamental to ensure that this competency is managed across an entire organisation, and not just focused on front line workers, associating them with different roles. The members of ISC recognised this as an area of work, to define competency across an entire organisation. This work, culminated in the release of a guidance document in 2015 detailed the process that had been undertaken by representatives of the ISC to develop and agree a process safety competency framework across an entire generic organisation, incorporating a range of competency levels. The members of ISC have lately identified that some roles were missing, and others can be combined. Those additional roles may have an impact or influence process safety and need to be recognised. In particular, some influential roles such as finance and procurement under support functions are introduced, as well as differentiation between quality assurance advisors and corporate assurance roles who would manage corporate audits. It is imperative to get process safety engineers be accustomed with roles and competencies associated with finance and procurement, with the intention of being able to communicate certain needs and obstacles relating to process safety in their role. With gaining knowledge about how to transfer concerns about resources and budget to the people in charge in the most effective way can improve the process safety performance of the entire company.

Introduction

Process safety competency was identified as an initial area of work for the ISC. The project consisted of reviewing the current guidance material available on this topic. There are several different organisations that have published guidance on how to establish a process safety competency framework. However, these documents stop short of actually defining different levels of competency for different roles – ie, developing the framework in a generic sense. The ISC's document (ISC, 2018) takes the step to create the generic framework, for different types of roles in an organization without addressing how to establish competency or define certification processes. Organisations should have their own competency assessment programmes; the guidance document informs the organisation of the process safety competence requirements for each role, so that it can be incorporated into their existing competence framework. Finance and procurement under support functions play a crucial role in process safety. It is imperative to get process safety engineers be accustomed with these roles and competencies with the intention of being able to communicate certain needs and obstacles relating to process safety in their position. And not only that, but also a healthy dialogue with process safety engineers is always beneficial prior to any modification in the procurement procedure.

1. Organisational roles and competency

ISC believes that a functional approach to process safety is important to increase people's understanding of their requirements. Process safety is about managing the integrity of operating systems by applying inherently safer design principles, effective engineering and disciplined operating practices. It deals with the prevention and mitigation of incidents that have the potential for a loss of control of a hazardous material or energy. Such loss of control may lead to severe consequences with fire, explosion and/or toxic effects, and may ultimately result in loss of life, serious injury, extensive property damage, environmental impact and lost production with associated financial and reputational impacts. Effective management of process safety requires leadership across six functional elements in an organisation. These are:

• culture
• knowledge and competence
• engineering and design
• human factors
• systems and procedures
• assurance

These elements can be thought of as a chain of safety, rather than applied to James Reason's Swiss Cheese Model (Reason, 1997). This is because we do not need failures in all elements to have an incident, but rather multiple failures in one element could result in an incident. The integrity of the chain is in the multiple layers behind it, hence demonstrated knowledge and competency in all elements is required across an organisation.

1.1 Establishing competency

To establish a competency framework, it is necessary to determine the topics of competency.
Eighteen topics were defined by the ISC partners as requiring specific process safety competency, based on the following guidelines:

• Centre for Chemical Process Safety Guidelines for Risk Based Process Safety (CCPS, 2007)
• Cogent and UKPIA Guidelines for Competency Management Systems for Downstream and Petroleum Sites (Cogent & UKPIA, 2011)
• Energy Institute Process Safety Management Elements (EI, 2010)
• European Process Safety Centre, Process Safety Competence - How to set up a Process Safety Competence Management System (EPSC, 2013)

These topics were then mapped against the six ISC functional elements. Some topics exist across more than one element; therefore, the most significant component has been selected as the primary. Within an organisation, these elements and topics may form part of a Safety Management System. Figure 1 shows the eighteen competency topics. Some elements have both technical and management aspects.

Elements	Topic
Culture	Safety leadership commitment, responsibility and workplace culture
Knowledge & competence	Process safety concepts
	Hazard identification and risk assessment
	Hazard awareness specific to the operation
Engineering & design	Safety in design
	Asset integrity
	Codes and Standards
	Management of change
Human factors	Human factors
Systems & procedures	Systems, manuals and drawings
	Process and operational status monitoring and handover
	Contractor and supplier selection and management
	Safe systems of work
	Project Delivery
	Management of major emergencies and emergency preparedness
	Incident reporting and investigation
Assurance	Legislation and regulations
	Audit, assurance, management review and intervention

Figure 1: Competency topics (ISC, 2018)

The main question about the competencies under support function is whether process safety engineers are involved in the decision-making process regarding financial and procurement questions or they need to work with what is purchased and accept if procurement hires third party workers that are not proved to be the best qualified team according to process safety engineers. What happens when the procurement office does not have adequate competency to select the best candidate or equipment that is required for a certain position or

process unit. Do they ask the department which requests the people or the pieces of Safety Critical Equipment (SCE), prior to selection or do they make their own decision? Is this really an issue in process industries?
Cogent and UKPIA (Cogent & UKPIA, 2011) published its guidance document for COMAH sites on competency management system and its requirements. One sub-chapter describes procurement of contractors and provides detailed instructions about a valid and accurate requirement specification, particularly for safety critical tasks. It emphasises the importance of delegating a technical authority or competent persons in setting up the specification to the requirement.
The following case studies and further dialogue with operators from various industries demonstrate the real significance of having the right level of competence in procurement and indirectly in finance. The studies also stress why it is crucial that these personnel ask and listen to the site process safety engineers prior to making any decision. Process safety engineers have the technical skill to propose certain SCE to purchase or contractors to hire; they know exactly what it means in production if the budget is reduced and employees are selected based not on their expertise.

2. Procurement failure via case studies

2.1 Procurement

In today's business environment, according to the Health for Humanity Report by Johnson & Johnson (Johnson & Johnson, 2016) sustainable procurement practices are increasingly driving companies' purchasing decisions, policies and reputation.
Despite the fact, that detailed description of procurement is not the scope of this paper, some basic knowledge is required to clarify the challenges on procurement in the chemical process industries. By the definition included in the Business Dictionary, procurement is “the act of obtaining or buying goods and services. The process includes preparation and processing of a demand as well as the end receipt and approval of payment. The process of procurement is often part of a company's strategy because the ability to purchase certain materials will determine if operations will continue” (Business Dictionary)
The procurement process is a part of the company’s corporate strategy and a vital component that helps in ensuring an effective supply chain management. The procurement procedure involves elements such as purchase planning, development of specifications along with supplier research and selection in case of new suppliers and contract administration. Some companies have an approved vendor’s list and others try to figure out which supplier is the best.
The Procurement Quality Assurance (Olk, Tristan, 2012) published by the National Aeronautics and Space Administration (NASA) reveals practice of acquisition procedures. It states that “procurement of aircraft parts without specific knowledge and expertise is a significant risk. Each center that operates aircraft currently handles parts acquisition differently, without a standard set of agency-wide processes or procedures. By consolidating aircraft parts purchases at the NASA Shared Services Center (NSSC), we have the ability to standardize the acquisition of quality aircraft parts and services. However, this is not without its own challenges. While some flying centers will see no impact since they acquire aircraft parts via existing maintenance contracts, other centers possess greater potential issues. Centers no longer have closed-loop systems to ensure that the aircraft parts they are purchasing are the parts that they receive. Non-flying centers may acquire Unmanned Aerial Systems subject to the same risks. If this situation is not addressed properly, we could be increasing risk to our aircraft fleet. Combining the knowledge of aircraft maintenance experts from each center with the NSSC may be the solution to providing parts and supplier assurance” (NASA, 2015).
During discussions with operators from various industries and countries, it became obvious that most of the time those who are responsible for process safety are not informed about changes in SCE’s and they learn it later when something goes wrong, or during test when they realise that the new component installed is not compatible with the original design. Sometimes it affects couplings used by both the operator and firefighters, others such as hoses or flanges that are designed to function under different circumstances or operation, the list is long.

2.2 Case studies

2.2.1 Experience with procurement process changed from local to less local

The case study is dated back in the 1980s and is about a Superintendent of a large pesticide manufacturing unit for which he worked also as the project engineer when it was built. Part of the Superintendent’s work was to run improvement capital projects in his plant and also get the engineering projects department to support the larger expansions. Their process called for the use of Quarter Turn Stainless Steel Ball valves of various sizes from 50mm bore upwards. The Superintendent would personally sign all the requisitions for new valves. These requisitions would be converted into purchase orders to suppliers. He would always specify the international standards for the design and manufacture of the ball valves and state the name of the supplier

and manufacturer. The standard was usually DIN or an American Standard which were well understood by the suppliers. In his mind the company had preferred suppliers and manufacturers whose valves had proved to be good quality and suitable for their rather difficult service. The local purchasing department always complied with the Superintendent's detailed technical and supplier requirements. A change in the purchasing function occurred and it became less local. In fact, it became more 'European'. To his surprise, when he specified the supplier and make of valve, his requirements were ignored, and the purchasing department procured valves which purported to be to the international standards required but were from a new and untried manufacturer. The Superintendent was not made aware and parts of the plant were then constructed with those new valves. After a number of incidents, they discovered that the design and engineering of these quarter turn ball valves had a flaw. When the valve was turned to the closed position where a mechanical stop would prevent further rotation it was not fully closed. Although it felt as if closed and it looked to be in the closed position, it was not. As a result, these incidents were followed with a long and angry argument with the procurement people who had signed a major contract with the new manufacturer to supply all the company's ball valves. This might have made economic sense in gaining a large discount, but as the engineers said, 'the bloody things leaked'. In the end the Superintendent was able to reinstate the original valve supplier until the problem was sorted out. The message is that it is vital that a proper approval process exists when procurement takes place for the new and untried supplier. And he believes that it cannot be left to the purchasing department.

2.2.2 Catalyst purchase

Two explosions and a subsequent fire occurred at SHELL Moerdijk on 3 June 2014 during start-up. The MSPO2 plant was out of operation to replace the catalyst pellets in two reactors. After the catalyst was replaced, operators prepared the unit with warming up the reactors with ethylbenzene. The explosion occurred soon after an unforeseen chemical reaction formed between the catalyst and the ethylbenzene. When the process was being developed, in 1977 SHELL did not observe any reaction between the catalyst and the ethylbenzene. Ethylbenzene was considered as inert substance under all process conditions. Based on this belief, any potential reaction between the two materials during warming up was not included in the plant's risk assessment. In the following years modifications were made to the plants and procedures involved in this chemical process. A new catalyst was selected for the reactor and tested between 1999 and 2000. During these tests, the circumstances during start-up were not considered, and the conditions that were considered deviated significantly from the plant conditions (Leveson, 2017). Furthermore, the tests focused on the production phase but not start-up. In 2011, the manufacturer of the selected new catalyst implemented changes in its production process. These changes were not communicated effectively to plant operators. Even though information was included in a Safety Information Sheet provided by the manufacturer, but they did not explicitly report the change to the plant. Safety engineering did not identify the increased potential for a chemical reaction between ethylbenzene and the new catalyst. Nobody ensured that the operators had all the necessary information available to them. In 2014, Shell Moerdijk performed a risk analysis for the new catalyst in the MSPO2 plant. In this assessment, they assumed that the properties of the new catalyst were the same as those of the previous catalyst. The report says that "The persons performing this risk screening reached this conclusion [of low or no risk] based on their knowledge and experience." It is not clear what this means. The company did not carry out any laboratory tests for the new catalyst, and the methodology used in the risk assessment was not suitable for testing complex substances, such as a catalyst.

2.2.3 Safety critical equipment and contractor

The Buncefield incident has many features that various publications have already highlighted; such as major technical problems through management and leadership, emergency response failures and land-use planning. The aspect that is explored in this paper covers both the purchase of safety critical equipment and procurement of a contractor company. All starts in 1987, seven years after the first tanks were built in the terminal and were fitted with non-checkable independent high-level switch. Those switches were slightly modified until 1987, when TAV Engineering Ltd (TAV) produced the first series of checkable switches. It contained a padlock to lock the switch in its home position. Then in 1996, TAV modified the design, applying a larger switch to get it easily accessible and simplifying the manufacturing process. However, in the new design the role of the padlock became safety critical as it was not a redundant system anymore.

It appears that nobody within Motherwell knew the safety critical significance of the padlock. The Independent High-Level Switch on Tank 912 was installed without the padlock. From the investigation it seems that Motherwell staff thought the padlock was for security 'anti-tamper' purposes only. Furthermore, new switches were fitted in 2004, specified with single pole double throw (SPDT) instead of single pole single throw (SPST). There was no management of change process carried out in any of these modifications, nor the delivery of manufacturer's documentation to the operators. The failures revealed in the COMAH report (COMAH, 2011) were as the followings: The process followed by Motherwell for ascertaining and then specifying the requirements of switches they supplied and/or installed was not adequate. They did not obtain the necessary

data from the manufacturer and it follows that they did not provide such data to their customers. They did not understand the vulnerabilities of the switch or the function of the padlock. There was a reliance on TAV, which was not justified given the lack of information provided and the critical role that Motherwell had in installing safety critical equipment. The site operator did not exercise sufficient oversight of the ordering, installation and testing procedure. While the switch was periodically tested, none of the staff at the site was aware of the need for the padlock to be replaced so that the test lever was held in the correct position. As Howard summarises in his paper (Howard, 2013) "the site operator placed high reliance on the technical competence of the contractor … but there was no evidence that this reliance was discussed with or agreed by the contractor in particular in relation to the requirements for a high-hazard site". In fact, there was no evidence of the performance of the contractor and delivery of their technical expertise.

2.2.4 Phosgene release – DuPont Belle

On January 23, 2010 a stainless steel braided phosgene transfer hose burst as an operator was inside the phosgene shed. He was exposed to the phosgene and died in the incident. Apparently, there was an ongoing dispute about the flexible hoses between the Belle, the La Porte DuPont companies and the corporate experts since 1987. DuPont standard listed acceptable construction materials for flexible hoses and recommended three types of those acceptable for use with phosgene. Corporate experts suggested the use of one of those hoses. However, the Belle facility followed the practice by the La Porte facility, using a flexible hose made of a polytetrafluoroethylene (PTFE) inner core and a braided stainless-steel reinforcement material. Stainless steel was not recommended for phosgene service, as it is susceptible to stress corrosion cracking from chlorides. In fact, extensive corrosion was localised under the area covered by the tape. The permeable PTFE and braided stainless steel of the hoses had provided an ideal environment that caused stress corrosion cracking. Furthermore, phosgene permeation through PTFE had resulted in leaks at Belle in the past; however, the PHA team did not consider this hazard for the phosgene cylinder hoses (CSB, 2011).

Although questions were raised concerning whether the hoses used were the ideal choice for phosgene transfer, the company had calculated the risk and cost-effectiveness of purchasing replacement hoses to be too high. This occurred even though, as of 2010, the Compressed Gas Association Standards for PTFE-lined hoses stated that the use of "PTFE-lined [hoses] are not suitable for use with poisonous, toxic, or pyrophoric gases because permeation of gas through the PTFE wall creates a potential hazard" (NASA, 2015).

2.2.5 Procurement of contractors – Case 1

The scope of the paper is also to analyse when procurement of contractors has failed. One example is the Xcel Energy incident that occurred on October 2, 2007 and caused the fatality of five and injured three workers. Apparently, corporate policies regarding contractor selection did not adequately ensure contractor safety performance for the project. After the pre-qualification process, the company reviewed the proposals and in this case the contractor's safety performance was graded as a zero, the lowest possible score. However, contractor disqualification from the bidding process was based upon financial capacity not based on past safety performance. The evaluation rating form stated that the score of zero did not meet minimum requirements and required automatic rejection; nevertheless, the contractor was still allowed to compete for the contract and its proposal was ranked as best based predominantly on its low price. The company's policies addressing contractor selection relied upon self-reporting and did not include specific procedures to verify contractor submissions (CSB, 2010).

2.2.6 Procurement of contractors – Case 2

On April 8, 2011, an explosion and fire occurred at a magazine that stored explosive materials. The explosion killed five workers and injured one. Contract workers were disassembling seized fireworks by federal law enforcement personnel. Without specific safety standards or contract stipulations to guide disposal efforts, the workers used unsafe practices and amassed large quantities of explosive material near tools and in containers that were capable of producing sparks, friction, and static electricity.

According to the findings of the U.S. Chemical Safety Board (CSB, 2013), "federal contractor selection regulations did not require the company procurement personnel to conduct a safety related review of Donaldson Enterprise (DEI) prior to awarding the company the contract". Furthermore, the company procurement personnel who gave the contract did not have adequate knowledge or experience related to fireworks disposal. Additionally, they were unaware that DEI had no firework disposal experience prior to the contract. In fact, the company's procurement office selected DEI because it was already storing the fireworks at the time under a separate contract with the company. And the final reason why DEI was the choice is that they submitted the lowest-cost and most time-efficient bid, which the company determined to be the best overall value for the government.

3. Conclusions

Competency is a key feature in process safety management, as it is underlined in the ISC guidance document. The examples presented above emphasise that finance and procurement under support functions play a crucial role in process safety. Companies supplying equipment or services to high-hazard facilities must understand their obligations and share information about safety critical equipment. The company needs to ensure that potentially critical changes are communicated to process engineers and plant operators.

It is imperative to get process safety engineers be accustomed with these roles and competencies with the intention of being able to communicate certain needs and obstacles relating to process safety in their position. In addition to that, procurement personnel should have the right level of competency to reach rational decisions without jeopardising the plant integrity. Along with that, a healthy dialogue with process safety experts is not only beneficial but recommended prior to any modification in the procurement procedure. They have the right level of competency and technical skills to determine what safety critical elements are really critical in the process and must not be altered as a consequence of cost reduction. When hiring contractors, the tender should specify the required qualifications, adequate knowledge and evidence from the contractor company. Procurement personnel should understand the severity of changing a supplier or hiring a new contractor company without reference. If procurement is not competent to assess this documentation the relevant technical authority should be consulted. Companies need to be intelligent customers when procuring services that may impact on the control of major accident hazards.

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