Effectiveness of Permit to Work Systems Narrative

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ABSTRACT

The main purpose of this paper is to review the effectiveness of Permit to Work (PTW) systems within current academic literature and build an understanding of what recommendations can be implemented to establish a PTW system that conclusively manages the risk and hazards that people undertaking high risk and non-routine work are exposed to. PTW is a control system that is used to assess and manage the hazards associated mostly with high risk work, such as work at height, hot work, electrical work or confined spaces as well as non-routine work. Failure of the PTW system can have catastrophic consequences as seen in the Piper Alpha oil platform explosion where 167 people were killed, the Longford Gas release and explosion where two people were killed and the Phillips Chemical Company fire at Pasadena where there were 23 fatalities. For this article the search terms 'Permit to Work', 'Permit-to-Work', 'Hot Work Permits' were used to retrieve journal articles on PTW systems from the University of Newcastle's library database. Two further criteria were applied - firstly, the article must be published after 1990 allowing for the last 30 years of major incidents to be captured, and secondly, any article that was attempting to sell a particular product was excluded as these articles were not reviewing PTW systems or major incidents causes but rather the effectiveness of their own products. In every system there are strengths and weaknesses. In reviewing the literature on PTW systems, five key weaknesses were identified: inadequate training, deficiencies of paper based PTW systems, failure of effective handover at shift change, weak leadership commitment to the PTW system and inadequate auditing scheduling and techniques. A PTW system must have a comprehensive handover procedure between shifts. If there is capacity to implement an electronic PTW system then this is preferrable to a paper-based system as long as it is customisable and covers all the requirements of a what is considered as a robust PTW system including: the authorised personnel, limitations of each permit, hazards and precautions identi-

Human Systems Engineering and Design (IHSED 2021)
https://openaccess.cms-conferences.org/#/publications/book/978-1-7923-8987-0

fied through risk assessment, the permit's validity time frame, handover and closure. In this review, it will be demonstrated that a PTW system that considers the five key deficiencies and overcomes these can be an effective PTW system.

Keywords: Permit to Work, Work Permits, Permit-to-Work

1 INTRODUCTION

Permit to Work (PTW) is a control system that is used to assess and manage the hazards associated mostly with high risk work, such as work at height, hot work, electrical work or confined spaces as well as non-routine work. PTW identifies who is authorised to carry out the work, the potential hazards of the work and work area as well as how these are controlled. Failure of the PTW system can have catastrophic consequences as seen in the Piper Alpha oil platform explosion where 167 people were killed (Broadribb, 2015), the Longford Gas release and explosion where two people were killed (Cann, 2014), the Phillips Chemical Company fire at Pasadena where there were 23 fatalities (Abbasi et al., 2021) as well as being the leading cause of industrial incidents in Korea 1996-2011 (Shin, 2013). PTW is an essential control for managing these high risk and non-routine work activities as at some large installations such as oil rigs, there can be up to 200 permits running at one time (Booth and Butler, 1992).

The main purpose of this paper is to review the effectiveness of PTW systems within current academic literature and build an understanding of what recommendations can be implemented to establish a PTW system that conclusively manages the risk and hazards that people undertaking high risk and non-routine work are exposed to. This review has been achieved through completing a Narrative Literature Review as outlined below in the method section.

2 METHOD

For this article the search terms 'Permit to Work', 'Permit-to-Work', 'Hot Work Permits' were used to retrieve 24 journal articles on PTW systems from the University of Newcastle's library database. Two further criteria were applied. Firstly, the article must be published after 1990 allowing for the last 30 years of major incidents to be captured. This will result in more recent learnings and improvements to PTW to be reviewed. Secondly any article that was attempting to sell a particular product was excluded as these articles were not reviewing PTW systems or major incidents but rather the effectiveness of their own products. These criteria resulted in 14 articles being suitable to review in relation to the effectiveness of PTW systems.

3 FINDINGS

Five key areas of weakness presented themselves as barriers to an effective PTW system:

1. Inadequate training
2. Deficiencies of paper-based PTW systems

3. Failure of effective handover at shift change
4. Weak leadership commitment to the PTW system
5. Inadequate auditing scheduling and techniques

Firstly, inadequate training of all who use PTW systems, with a particular focus on the competency of the permit authorisers in assessing the risk for the work, can cause a PTW system to fail due to work being approved without all the appropriate risks being reviewed (Graveen, 2017) (Hodson, 2009) (Gould, 2007) (Abbasi et al., 2021) . Secondly, there were several discussions on the weakness of paper-based PTW systems and the benefits of moving to an electronic based approach (Matsuoka and Muraki, 2002) (Iliffe et al., 1999) (Hodson, 2009). While this does not conclude that you cannot have an effective paper-based PTW system, there are greater benefits to transitioning over to an electronic PTW system that allow for better communication and risk comparison. The failure of adequate handover at shifts, as seen as one of the major causes behind the Piper Alpha Disaster and Longford Gas Explosion, was demonstrated to be a key aspect of every PTW system that needed to be addressed in the literature reviewed (Booth and Butler, 1992) (Jahangiri et al., 2016) (Broadribb, 2015). A lack of leadership commitment to the PTW system and its implementation was also seen to be a weakness as this demonstrated a low safety culture in which PTW systems are not followed or are not used as intended (Shin, 2013) (Broadribb, 2015). This can result in an effective PTW system becoming ineffective due to a lack of use or adherence to it. Finally, the last key deficiency noted was a lack of quality auditing of the PTW system to review its effectiveness and adherence to the system (Mousavi et al., 2019) (Broadribb, 2015).

These five weaknesses demonstrate how what was considered to be an effective PTW system can turn out not to be. It would be remiss to believe that businesses have adequately addressed these weaknesses in PTW systems, and it would be wise to review and implement change as required based on these findings.

4 DISCUSSION

PTW is a system that provides a framework of how to conduct a work activity safely and control the risks related to this activity, however throughout this review it can be demonstrated that many PTW systems are not fit for purpose. Mousavi states that in studies completed, about 30% of permit to work systems in the process industry suffer from some form of deficiency (Mousavi et al., 2019). With this in mind, let us review the various deficiencies that have been documented in these academic articles.

4.1 TRAINING

A permit is just a piece of paper that can be ticked and flicked states Graveen in her article (Graveen, 2017), which is very true. The issuing of a permit does not make a job safe; it is dependent on the capability of the issuer removing known hazards . The permit authoriser must have demonstrated capability to understand the risks and hazards involved and how the work can be done safely. In a PTW system, the permit authorisers must assess the work procedure, and check the safety at all stages of the work (Jahangiri et al., 2016), and as such, if they do not

have the capability and training to be able to do this effectively, then the permit does become a tick and flick exercise only. Hodson discusses the need for permit authorisers to have extensive training in the use of the PTW system and sufficient knowledge and experience in relation to the specific permit they are looking at approving (Hodson, 2009). Without these, a well-built PTW system can fall over, as work can be approved that should not have been, as it has not been competently assessed. Increased training was one of the improvements that eventuated out of the Longford gas explosion. A rigorous training program was implemented for maintenance workers, authorisers and validators so that they could demonstrate capability in using the PTW system without manuals and issuing of permits that were specific to their area of expertise (Cann, 2014). Gould also comes to this conclusion in his review of PTW systems in the process industries (Gould, 2007). He concludes that workers at a site should have knowledge of and be familiar with the PTW system, and their training should be in line with their level of involvement of the permits. Training of the people involved in the PTW system cannot be underestimated in the effectiveness of the PTW system. If those involved in completing and issuing the permits are not trained and competent to do so, then the risks are not going to be adequately assessed and unsafe work conditions will exist.

4.2 PERMIT TO WORK SYSTEM TYPES

There are two types of PTW systems currently in use in industry: paper-based systems and electronic PTW systems, with paper-based systems being the most common (Hodson, 2009). There are significant benefits to using an electronic based PTW system over a paper-based one. Firstly, legibility; a handwritten permit may not be able to be read due to handwriting deficiencies, the actual permit disintegrating or becoming dirty and it therefore becomes illegible and there is the potential for loss of vital information (Iliffe et al., 1999). Electronic PTW systems remove these legibility issues as well as allowing for greater control over communication and co-ordination of the permits. All permits will be located in one place – easily accessible and able to be compared against previous incidents, near misses and against the schematics of the work site for more accurate assessment of the risks related to the work through transaction processing (Matsuoka and Muraki, 2002). Electronic PTW systems can be bought ‘off the shelf’ and this does open up the risk that a business may believe they have implemented a solid and effective PTW system but the permits are too generic and therefore do not adequately capture the risks and controls required to safely work (Hodson, 2009). The permits themselves, must contain specific information on the job that capture the whole scope of work but not be overly complicated . Generally electronic PTW systems suffer from three weaknesses: they are uninformative and do not guard against all possible hazards, they lack clarity as users fill in boxes which they feel are clearly explained but to another they are not comprehensible, and they can be inflexible instead of being specific for that site (Iliffe et al., 1999). A PTW system should clearly detail the authorised personnel, limitations of each permit, hazards and precautions identified through risk assessment, the permit’s validity time frame, handover and closure (Hodson, 2009). This would make the PTW system be fit for purpose.

4.2 HANDOVER

It is particularly important in both a paper-based and an electronic PTW system that handover is covered adequately. The inadequate handover in both the Piper Alpha and Longford gas explosions contributed to those events due to the next shift being unaware of what work had been completed which allowed for machinery to be switched back on when it shouldn't have been (Cann, 2014) (Jahangiri et al., 2016) (Broadribb, 2015). Using either type of system (paper-based or electronic), should always ensure the handover log is comprehensive. After the Longford gas explosion, a new system was implemented where a permit could not be re-authorised until 30 mins after shift change over to allow for the new shift supervisor to find out what has happened on the previous shift and what they need to re-authorise (Cann, 2014).

4.4 LEADERSHIP

Broadribb states, "The quality of leadership and commitment to safety can drive or limit the safety culture of an organisation" (Broadribb, 2015). While not the actual PTW system itself, the quality of the safety culture at a site can lead to workers following the PTW system or disregarding it (Broadribb, 2015). Shin's analysis of South Korea's major industrial accidents found that violating work permits was the major cause of the accidents, demonstrating the lack of embedded safety culture and advises rectifying this to fix the issue (Shin, 2013). Incident six, where a contractor was overcome by chemical fumes, and incident seven, where an employee was killed as a result of a fire, from the "Permit to Work Incidents – in brief" illustrate what can occur when there is deficiencies in following the PTW system . In both cases, there was a failure to implement the PTW system fully and enforce the conditions of the permits. One of the lessons learnt from the Piper Alpha disaster was that managers need to develop and maintain a safety culture that is built on the understanding that long term safety yields better production and that safety can't be compromised by placing more importance on cost or production (Broadribb, 2015). Implementing an effective PTW system does not just rely on the PTW system being fit for purpose, it also relies on the leadership demonstrating, and expecting compliance to the system at all times knowing that this is better for the business in the long term.

4.5 AUDITS

Once a PTW system has been implemented, it is not enough to leave it as is. There is a need to endeavour to continually improve the PTW system through regular auditing. This is done to confirm the adequacy of the system and that there is complete adherence to it. After the Piper Alpha incident, it was noted that safety system audits were superficial and not conducted with rigor and so did not identify system deficiencies (Broadribb, 2015). After the incident, regular effective auditing was scheduled with specific scope and qualifications of those to do the auditing in place so that the audit was rigorous and did perform the duty of an audit: that is, find room for improvement (Broadribb, 2015). It is noted that

other companies such as Shell also use regular audit checklists to assess the compliance of the PTW system by reviewing the system, qualifications, training, work permit form, monitoring and isolation (Booth and Butler, 1992).

A fully functional PTW system will incorporate regular rigorous auditing that result in improvements (Cann, 2014). Furthermore, regular and comprehensive auditing demonstrates to the workers that leadership is committed to the PTW system and the safety culture of the site will improve (Booth and Butler, 1992).

5 RECOMMENDATIONS

The results of this literature review demonstrate the importance of implementing an effective PTW system. Without one there can be catastrophic consequences. Five key deficiencies of current PTW systems were reviewed and by analysing these areas of any PTW system, considerable improvement can be made. Implementing an effective PTW system can be done by focusing on auditing current practices with a view to improving processes, review training and upskilling workers if required, analyse options for an electronic PTW system that include effective handover practices, and for leadership in the business to demonstrate their commitment to the PTW system and the safety of their workers and contractors.

Auditing current PTW systems will provide a baseline of the effectiveness and adequacy of the current system. Auditing should be conducted by trained auditors on a regular schedule. After the Piper Alpha explosion, weekly, monthly, quarterly and annual audits were implemented to provide detailed information on how the PTW system is performing and what changes could be implemented (Cann, 2014). Depending on the scale of your operations it is recommended that a similar auditing schedule be implemented. It is important to note that the competency of the auditors will drive how well the PTW system is reviewed so it is vital that auditors are qualified and competent to conduct this task.

A PTW system is only as effective as the people approving the permits, therefore it is vital to ensure that the permit authorisers have up to date skills on the PTW system as well as the knowledge and experience to be able to competently assess the risks and put adequate controls in place. Conducting an audit of the current PTW system will determine if this is an area where there are deficiencies that need to be rectified. Ensuring ongoing regular training will also embed the PTW system and how it is meant to be used. Since the Longford Gas explosion, a more intensive training program was implemented including testing maintenance workers, authorisers and validators in a 2-hour practical test to demonstrate competency in using the PTW system (Cann, 2014). This practical testing is an effective way of ensuring proficiency and this is recommended to be implemented as a part of any PTW system.

Electronic PTW systems allow for greater communication through the business, comparison against permits that are currently out, as well comparing risks against of the work against previous incidents and near misses. It also can eliminate the risk of damage to the physical permit. It is recommended to review current electronic PTW systems, specifically being aware of when buying systems ‘off the shelf’. The electronic systems do need to be customisable so that they do not become a source of risk itself by being too generic and inapplicable to the individual site needs (Hodson, 2009). An electronic PTW system that is cus-

tomisable and covers the authorised personnel, limitations of each permit, hazards and precautions identified through risk assessment, the permit's validity time frame, handover and closure will be a much more effective system (Hodson, 2009).

Handover is of critical importance and an integral part of any PTW system. This must be considered in an effective PTW system and a procedure must be implemented where the next shift can definitively know what permit work is currently being undertaken. It may be that the system implemented after the Longford gas explosion, where a permit can't be reissued until 30 mins after shift change, is suitable depending on the scale of the business (Cann, 2014).

Most importantly, for a PTW system to effectively work it must have the support of the leadership in the business. This is applicable to all safety systems but without strong leadership, you can implement an excellent system, only for it to fail due to a lack of discipline and accountability to adhere and comply to it. A leadership team that understands a commitment to safety will benefit production in the long term, and will be much more effective at implementing a PTW system than one that puts costs or production over safety (Broadribb, 2015).

6 CONCLUSION

The main purpose of this paper was to review the effectiveness of PTW systems within current academic literature and build an understanding of what recommendations can be implemented to establish a PTW system that conclusively manages the risk and hazards that people undertaking high risk and non-routine work are exposed to. Effective PTW systems are not an unachievable goal for business. As demonstrated through this review, a PTW system that considers the five key deficiencies discussed and overcomes these can be an effective PTW system. A business with leadership that drives a culture of safety as number one, can implement and gain adherence to an effective PTW system. Regular and comprehensive auditing of the PTW system including the training of personnel who use the system will enlighten the business on where there is room for improvement. A PTW system must have a comprehensive handover procedure between shifts. This has been demonstrated to have fatal consequences if it is not implemented effectively. If there is capacity to be able to implement an electronic PTW system then this is preferrable to a paper-based system as long as it is customisable and covers all the requirements of a what is considered as a robust PTW system including: the authorised personnel, limitations of each permit, hazards and precautions identified through risk assessment, the permit's validity time frame, handover and closure. If a business considers these measures when implementing their PTW system, then they are well on their way to establishing a PTW system that conclusively manages the risks and hazards of high risk work.

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