

Situation Awareness in Railway PICOPs

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Abstract

Situation awareness in the railway is extremely important due to its dynamic nature which means that operators have to perceive, understand, and act on continuously changing information. This is true in engineering work, as well as operations. During engineering works, a PICOP (person in charge of possession) needs to keep track of multiple different factors, such as the number of RRVs/OTMs being used, number of worksites, points movements, and train movements, to ensure the safe running of the requiring high levels of situation awareness. Observations were undertaken to gain an understanding of the job as a whole in order to ultimately generate recommendations on how to better support situation awareness. This paper maps the PICOP role to Endsley's three levels of situation awareness.

Factors include track layouts, and the number of worksites

KEYWORDS

PICOP, Situation Awareness, Railway

Introduction

Situation awareness is defined as the understanding an individual holds of the events occurring in their current situation (Endsley, 2021). In complex systems i.e., railways, conditions can rapidly change. Individuals need good levels of situation awareness to help make the best decision they can in any given moment. Situation awareness, alongside an organisation's rules and procedural information, allow for decision making to occur. Endsley's (2021) situation awareness model can be divided into three sublevels (Figure 1). Level one: perception, two: comprehension and three: prediction. The levels are linked but do not necessarily occur in strict chronological order. The levels represent increasingly higher levels of situation awareness. An individual with good amounts of perception and comprehension of situation awareness can combine to lead to a great amount of level three situation awareness, prediction.

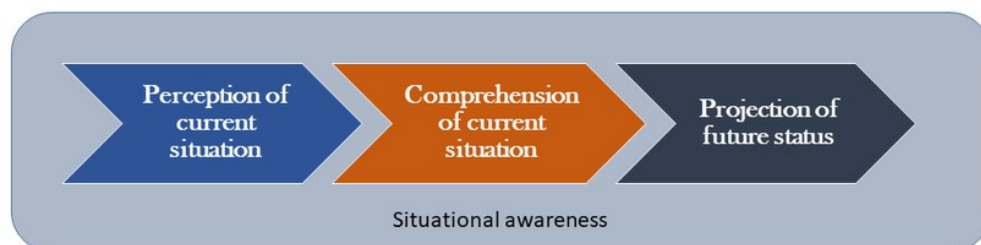


Figure 1: Three levels of Endsley's Situation Awareness (David, Lobov & Lanz 2018)

Signallers are responsible for the rail network and are in control of almost all movements on the line. When engineering or maintenance work is required on the track, or neighbouring infrastructure

that cannot be completed in between the daily running schedule of trains, a T3 possession is required. A T3 possession is where a PICOP (person in charge of a possession) takes responsibility for a section of the track from a signaller in order for maintenance to occur. The PICOP is then responsible for what happens within that section of the track: they take ‘possession’ of the railway from the signaller. A possession often includes multiple worksites within its limits, each controlled by an ES (Engineering Supervisor). The ES controls anything that occurs within their worksite limits (Figure 2). The PICOP oversees and coordinates with ESs setting up their worksites and the two need to communicate and cooperate to control movements entering and/or exiting worksites. PICOPs are also responsible for liaising with the signaller to move points as required and ensuring OTMs (on track machines) and RRVs (road rail vehicles) have the correct route set for any movements needing to be made. The PICOP needs to give permission to operators of RRVs and OTMs to carry out any movements inside the possession but outside of worksites. There are often multiple RRVs working in one possession.

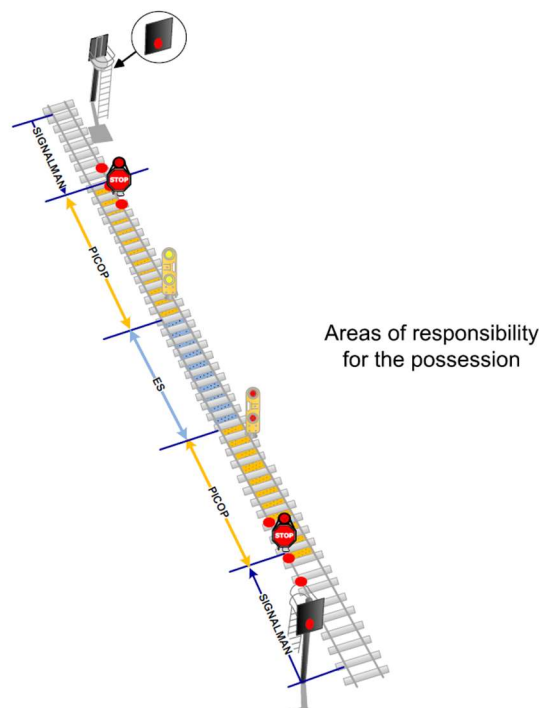


Figure 2: Areas of control within a possession (Irish Rail, 2019)

There are numerous different factors which can affect the complexity of the possession. Factors include track layouts, the number of RRVs/OTMs being used, and the number of worksites (Wilson et al., 2008). The PICOP needs to keep track of everything; therefore, it is very important that they maintain a high level of situation awareness to ensure possessions run safely and efficiently. This paper maps the three levels of situation awareness to the current provisions for a PICOP to be able to assess how their situation awareness is currently supported. With an overall project aim to highlight areas where more support may be required and provide recommendations for improvement.

Method

The main form of data collection for this project was observations. Nine observations occurred in seven different locations, observing six different PICOPs and one ES. Two observations happened during daytime possessions, while the remaining seven occurred during the nightshift, as possessions more commonly occur at night. All observations took place in the normal location of the PICOP when managing their possessions. Locations include a PICOP room (dedicated PICOP

office), in the canteen, a spare office, or on the track itself. The observations were undertaken to gain an understanding of the job and what it entails, and to identify any differences in working practices. A classroom based PICOP training course was attended and semi-structured interviews with competency assessors were undertaken with the aim of understanding the training provisions in place. Semi-structure interviews with possession planners occurred to discuss and understand the planning process. The rule book and relevant procedural documentation were also reviewed to understand the relationship between the observed activities and the expected activities.

Findings

Level One Situation Awareness: What does a PICOP need to know during a possession to ensure situation awareness?

This level regards an individual's perception of their environment and everything in it (Endsley, 2021). The information can be perceived through a range of senses and can be both directly and indirectly observed. It can be through direct observation or through verbal or written communications (Endsley, 2021).

Being physically remote from the possession, a PICOP has no way of directly observing what is happening on the ground. Even when managing the possession on track, the span of the possession is usually too large for one individual to physically see all of it. PICOPs rely on pre-prepared information sheets such as work plans, possession maps alongside informational phone calls. Weekly work plans are provided which detail all the worksite information and contact details for the workers. Possession maps are static visual representations of the possession area. Each map highlights key information that is relevant to the possession, such as access points, protecting signals, required detonator positions and point numbers. All information provided is second hand and not observed by the PICOP themselves. When plant and machinery are involved in possessions, internal procedures require that controllers/PICs (Person in Charge) receive permission from the PICOP before making any movements within the possession that are not within worksite limits. Currently the PICOP uses possession arrangement forms, train forms and often a notebook in order to keep track of what is happening in the possession. A lack, or a low level, of situation awareness may cause incidents to occur which may have a financial impact to the company. An example being a points run-through, where machinery such as RRVs travel through a set of points which are not in the correct position for that movement which might cause damage the infrastructure. The damage has a cost to repair, as well as delaying the planned work during the possession.

Worksite specific details such as protecting signals and protection detonator locations as well as times when certain actions are taken, such as when the possession is granted, or when worksites have been fully set up are recorded on the forms. There is a lack of space available for all necessary information. For example, the forms have space for the locations and times points are secured at, however there is no space for noting down any point changes that occur during the possession. The PICOP either just remembers the changes or notes down the information on a scrap of paper, if available.

To help support a PICOPs level one situation awareness, it would be beneficial to redesign the possession arrangement form to improve it by providing better space for information. Endsley (1999) created a situation awareness error taxonomy to categorise the most common types of factors that affect situation awareness for each level. Factors for level one includes not having the data available, memory loss and data that is hard to detect. Memory loss and forgetting about information presented may be caused by having a high task-load which can interfere with information being attended to and distractions/disruptions, both which PICOPs can experience especially when setting up their possessions (Endsley, 1999). Providing space to write down all the information on the possession form may reduce the PICOPs reliance on memory. Golightly, Balfe,

Sharples and Lowe (2012) explored situation awareness in signallers where they explained that the signalling displays allow signallers to access the information as required so that they do not have to retain the information in their working or long-time memory.

Level Two Situation Awareness: What meaning does a PICOP take from information provided?

Level two builds from the first level, as it considers the understanding an individual has of their environment and the circumstances of specific situations (Endsley, 2021). It takes all the different sources of information about an environment collected in level one and provides significance for the different elements. It can help an individual determine the seriousness of problems which may occur. Theoretically those with more experience in an area will be better at this than novices (Endsley, 2021).

To become competent as a PICOP for the first time, there is a requirement for the individual to attend classroom-based training alongside a competency assessment of them taking a possession. After becoming competent there is a refreshment cycle every two years where the PICOP needs to attend refresher training followed by a competency assessment. Some divisions organise a period of work shadowing that occurs between the classroom training and the competency assessment to allow a new PICOP to observe an actual possession being taken. This helps the new PICOP to add context to the information they received in training and see how it is applied to an actual possession.

During a possession, the PICOP relies on their local knowledge of an area in order to interpret and make sense the different forms of information provided. Local knowledge helps the PICOP know which are the best routes for RRV/OTM movements across possession and which points need to be changed to facilitate that. The local knowledge, in addition to possession arrangement forms, possession maps and any supplementary notes that have been made throughout the night, all help the PICOP to manage any movements that occur and help the PICOP to be able to deal with any information given to them verbally on the night. A lack of local knowledge may lead to mistakes such as points being moved in the wrong direction for movements which could lead to damage or derailments. The classroom-based training highly emphasises the importance of local knowledge to make sure the PICOP has context to the information they are provided, for example knowing which was to move points for specific movements. However, there is no formal process to help PICOPs acquire this local knowledge.

Although work shadowing is organised for newly passed PICOPs in some divisions, it does not occur in all locations. The introduction of work shadowing throughout the remaining divisions may help new PICOPs in their understanding of taking possessions. Observing a possession being taken, could help new PICOPs to understand the information being given to them as it will help them take what they learnt in the classroom and see how it occurs in an authentic setting (Wilks & Ross, 2014). It can help new PICOPs understand how different pieces of information are important in the area they will be working in. It would be a great opportunity for new PICOPs to ask specific questions about why things are done in specific ways. Kopp and Minder (2016) studied job shadowing in skills trainers and found it to be a positive experience providing an opportunity to ask experts questions while they were completing the role and model good practice for the observers.

Another way to support situation awareness of PICOPs is to help ensure a PICOP has excellent local knowledge. Introducing a more formalised assessment of an individual's local knowledge would be beneficial to ensure they have the ability to assess the information provided and apply the context of the specific location to be able to help identify if/when problems occur. It is important that PICOPs start the job with excellent local knowledge of their area and maintain it throughout their career. PICOPs commonly work in one area which means PICOPs would not need to be familiar with large areas of land. Testing of local knowledge could be conducted in similar manner to that of drivers, as their route knowledge is regularly tested to ensure it is maintained.

Level Three Situation Awareness: What tools do PICOPs need to be able to anticipate potential future events?

Level three of Endsley's (2021) model of situation awareness looks to the future and the ability an individual has to predict and project into the future, to predict possible situations that might occur. Level three is achieved by combining both levels one and two (Endsley, 2021). Being able to predict possible situations aids in decision making and being proactive about choices being made (Endsley, 2021).

The railway is a dynamic workplace and PICOPs are expected to be able to deal with situations as they occur. OTMs and RRVs often have to travel through a possession to reach a specific worksite. The PICOP is responsible for planning movements and liaising with signallers to ensure points are in the correct position. RRVs often have to complete repetitive movements between locations. The PICOP will need to use their situation awareness in order to plan a route and predict any obstacles that may appear, then fix them before the movement is given permission to occur. PICOPs are also responsible for ensuring all work is completed in a timely manner to ensure that the track is clear and safe for train to run in time for the scheduled hand back. Forms and notebooks enable a PICOP to keep track of everything. They note down information such as points movements and positions to help facilitate RRV or OTM movement requests. They also encouraged the use of possession maps which give the PICOP a static view of the area.

To help support level three of Endsley's (2021) situation awareness model it may be beneficial to provide PICOPs with an interactive visual representation of the possession. Building on the current possession maps, giving PICOPs the ability to add the details of the current possession, such as worksite locations and points positions, might provide a clearer picture of what is happening on the track especially when movements are concerned. An alternative to this is allowing the PICOP to have access to a read-only version of the signalling schematic. This would allow the PICOP to see exactly what is happening in real time. The schematic might be able to help the PICOP anticipate problems or issues quicker by seeing the possession visually rather than having to read written information to determine locations and movements. Garner and Stiles (2013) explain that it is important to have up-to-date information when taking possession as it is essential for accurately understanding the environment and can help to predict potential areas of conflict.

Conclusion

A PICOP completes maintenance possessions on an almost daily basis. A high level of situation awareness is important for them to be able to manage and keep track of the different moving parts of a possession. An investigation into the role of a PICOP was conducted, with the aim of understanding what the PICOP role entails and to identify ways in which their situation awareness can be further supported.

Currently a PICOPs perception of their environment (situation awareness level one) is supported through pre-prepared documents containing information specific to that possession alongside phone calls from track workers, such as ESs and controllers of RRVs, providing information about what is occurring on the ground in the possession. Information is added to possession arrangement forms. If the information is not required on the forms, such as points movements and positions, it is either remembered or noted down on scrap paper. Redesigning the possession arrangement form to create more space for the PICOP to record additional important information would be beneficial so as to not rely on the PICOP remembering the position of assets/infrastructure memory or having to note it down on scrap paper.

Level two of situation awareness is currently supported for PICOPs through comprehensive classroom-based training where there is an emphasis on having excellent local knowledge,

alongside a competency assessment before being allowed to take a possession by themselves. Local knowledge, and information documents such as possession arrangement form, work plans and possession maps all help to give the PICOP context to the information they are receiving. Work shadowing, although present in some divisions, is not offered in all divisions. A recommendation is the introduction of work shadowing in all divisions as it would enable new PICOPs to understand the significance of different pieces of information and provide examples on how possessions should be taken. Investigating the potential of developing an assessment to test a PICOPs level of local knowledge would help to ensure the PICOP has the context to identify when potential problems might occur.

Situation awareness level three where individuals predict into the short-term future, is supported through possession maps and communications between track staff and PICOPs to keep them aware of movements of RRVs being made. Potentially providing an interactive representation of the possession where a PICOP can add details and locations of specifics in their possession might help the PICOP maintain a better situation awareness of the possession as a whole. Alternatively, allowing the PICOP to access a read-only signalling schematic, where they can see everything playing out in real time could help PICOPs when identifying potential conflicts or problems.

Overall, during possessions, a PICOPs situation awareness is supported on all three levels of Endsley's model. Through the forms they complete and notes they write during a possession, to the local knowledge they need to maintain, and the documentation they are given before the possession occurs. The observations from this research have highlighted potential areas for improvement in order to provide additional support for current and new PICOPs. Such as a potential review into the possession arrangement form, assessment of level of local knowledge, work shadowing, and possible visualisation of the possession through an interactive representation of read-only signalling schematic. All of the potential areas of improvement could help increase a PICOPs situation awareness which can help with the safer and efficient running of possessions on the network.

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