Al Hour, S. N., Ebbs, P.J., Manu, E. (2025). Direct Work Observations for Workflow Improvement and ISO 18404 Competency Development. In O. Seppänen, L. Koskela & K. Murata (Eds.), *Proceedings of the 33rd Annual Conference of the International Group for Lean Construction* (IGLC33) (pp. 1573–1584) https://doi.org/10.24928/2025/0219

DIRECT WORK OBSERVATIONS FOR WORKFLOW IMPROVEMENT AND ISO 18404 COMPETENCY DEVELOPMENT

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ABSTRACT

Direct Work Observation (DWO) is a fundamental Lean technique used to interact with site teams and observe critical activities to improve processes. The process of DWO includes planning the study, observing processes, collecting data, interacting with site teams and identifying areas for improvement. DWO are also reported as first run studies and time & motion studies, however, their use aligned with ISO 18404 competency development is unexplored. By sharing how DWOs were conducted, and the approach taken, this paper explores the dual role of DWOs to improve workflow and support Lean professionals in achieving ISO 18404 certification. Out of 25 DWOs conducted across a UK highway alliance, three DWOs are explored in this paper because they involved ISO 18404 candidates who were seeking to develop their portfolio of evidence whilst improving workflow. Insights from interviews with ISO 18404 candidates reveal that DWOs contribute significantly to both ISO 18404 hard and soft skill development, aligning with the framework's requirements. Some challenges were also identified, such as lack of make-ready that contributed to waste and inefficiencies, the danger that site teams could feel they were being audited, and the risk that enough follow-ups to DWOs are not conducted to measure improvement effectiveness.

KEYWORDS

Direct Work Observation, ISO 18404, Make-Ready, Lean Competencies, Alliancing

INTRODUCTION & BACKGROUND

Direct Work Observation (DWO) is a useful Lean method that helps understand how the work is done on site, identify waste, and improve workflow. It follows a step-by-step approach where teams go to site and see the work directly to get a clear understanding of what is happening (Seppänen & Görsch, 2022; Koskela, 1999). During this process, the work is broken down into 3 elements: value-adding (VA), support activity (SA), and waste (W). Observers gather accurate data and spot challenges by observing site activities, and work with construction teams to come up with a better way of doing things. Ohno (1988) emphasised the importance of going to the source to observe work firsthand, which directly relates to the core idea of DWOs in Lean construction. He stressed that managers and supervisors should personally observe the work happening on-site to identify inefficiencies and drive improvements (Ohno, 1988).

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DWO is not a new technique as it shares similarities with practices like time and motion, first-run studies and work sampling, which are all aimed at understanding and improving how work is done in construction. For example, Seppänen and Görsch (2022) looked at how structured observations helped improve MEP (Mechanical, Electrical, and Plumbing) tasks, while Memarian and Mitropoulos (2012) showed that observing concrete construction in a systematic way can make the process more reliable. Neve et al. (2020) analysed DWO data from North America between 1972-2010 to identify opportunities for construction labour productivity improvements. Demirkesen et al. (2022) used time and motion studies to identify value and non-value adding activities and select the best strategies for productivity improvement. Wandahl et al. (2021) extensively reviewed 72 previous studies and 474 case studies on work sampling to identify a baseline for direct work, indirect work and waste work across projects. This was to identify opportunities to minimise waste time and improve construction site efficiency. These examples show that by carefully watching how work happens, it becomes easier to identify impediments to flow and come up with better ways to do the job. However, none of these previous studies have focused on testing DWO type methods for Lean competency and portfolio development to support candidates in achieving ISO 18404 certification requirements for Lean practitioner, leader and expert levels. Also, previous studies on Lean competency development have focused on how competency-based construction curriculum and training programmes align with Lean philosophy (Kpamma et al., 2014), how the output of being Lean competent improves health and safety on site (Evans et al., 2022), with limited studies focusing how to support candidates in developing their portfolio and providing evidence of application of Lean in practice. ISO 18404 is an international sector-agnostic Lean competency framework that has 18 competencies for leaders and experts, and 13 for practitioners (ISO 18404, 2015). This framework has been reported as a model for Lean transformation (Ward and Caklais 2019, Ward 2019, Ebbs & Ward, 2024) and central to that is the development of key personnel who complete ISO 18404 individual portfolio. A research question that remains unexplored is then how DWO type methods can support 18404 key personnel on their competency development. The study's aim is to investigate the potential of using DWOs to develop ISO 18404 Lean competencies.

DIRECT WORK OBSERVATION (DWO)

Direct Work Observation (DWO) is built upon established principles of process improvement seen in construction through methodologies such as time and motion, first-run, and work studies (Oglesby et al., 1989) and involves going to the Gemba. Frank and Lillian Gilbreth pioneered this method by studying and improving the bricklaying process to make it more efficient (Gilbreth, 1909). These approaches focus on breaking tasks down to identify inefficiencies and streamline workflows. Frederick Taylor's principles of scientific management provide a strong theoretical foundation for DWO, emphasizing the importance of developing a systematic approach to work, selecting the right tasks to study, and cooperating with workers to ensure improvements are effectively implemented (Taylor, 1911). Taylor's emphasis on analysing each element of work scientifically aligns with the core objectives of DWOs in identifying VA, SA, and W within construction workflows. Work sampling is another type of DWO, which after screening 72 previous studies, Wandahl et al. (2021) categorised into direct work (DW), indirect work (IW) and waste work (WW).

Make-ready is another important technique to improve workflow reliability (Ballard, 2000). Ebbs et al. (2024) maintain that when make-ready is not done well, delays, missing materials, and other problems that affect the workflow arise. One of the examples outlined in this paper, conducted a dedicated make-ready planning session twice a month to identify constraints as a countermeasure for the issues found during DWOs.

According to Oglesby et al. (1989, p. 185), choosing the right area to observe is key to getting the most improvement. If the wrong area is picked, efforts might not bring much benefit. This idea goes hand in hand with what Taylor (1911) stressed i.e., management should carefully plan and select tasks based on proper observations and data, rather than just relying on experience or guesswork. Furthermore, Oglesby et al. stressed the need for a detailed plan before starting any observation, which supports Taylor's approach.

Another key success factor is getting the team involved on-site. Taylor highlighted that for any improvements to stick, management and workers need to work together in alignment. This is particularly true in Lean construction, where having early conversations with the team and being clear about what is happening can reduce resistance and encourage cooperation (Oglesby et al., 1989, p. 154; Harada, 2015). When workers are involved from the start, they feel more valued and are more likely to share useful ideas (Taylor, 1911).

Even though DWOs bring a lot of benefits, sustaining improvements is not easy. Taylor (1911) pointed out that regularly checking on work and having clear standards are key to making sure improvements last. This idea fits well with the need for follow-up DWOs to see if the changes made are working and to measure their impact (Oglesby et al., 1989, p. 216; Memarian & Mitropoulos, 2012). Without these follow-ups, there's a risk that any progress made could fade away, and the same problems might reoccur.

DWOs and ISO 18404 Lean Competency Development

Another potential of DWOs is their role in supporting Lean competency development, helping ISO 18404 Lean Practitioners, Leaders and Experts complete their portfolios of evidence. There is an opportunity to investigate the potential of using DWOs an effective way to gather this evidence by allowing candidates to work closely with stakeholders, track how well processes are working, and spot areas that need improvement. ISO 18404:2015 sets out 18 Lean competencies as shown in Figure 1. Thirteen of these are Lean Practitioner competencies with an additional five required for Lean Leader and Lean Expert certifications. Many of these competencies are required to conduct robust DWOs.

Figure 1: ISO 18404 Lean Practitioner, Leader and Expert Competencies (National Highways | SMP Alliance, 2025)

The Lean competencies in Figure 1 are a mixture of hard and soft skills that candidates must demonstrate through a portfolio of evidence to RSS (Royal Statistical Society) approved assessors in the UK. Depending on the level of individual certification to either Lean or Six Sigma i.e., Practitioner/Green Belt, Leader/Black Belt, Expert/Master Black Belt, candidates

are required to demonstrate compliance to each competency's criteria at four levels – understanding, applying, managing and training. The higher the qualification, more competencies and criteria must be satisfied. For example, an ISO 18404 Lean Practitioner must satisfy 13 of the 18 competencies. Their portfolio will include a total of 32 work packages (4 understanding, 23 applying, 4 managing, 1 training) and they must be able to demonstrate each work package complies with the ISO 18404:2015 competency criteria. On the other end of the scale Lean Leaders and Experts have 72 and 85 packages of work respectively.

LINKING DWOS WITH ISO 18404 COMPETENCIES

The 13 ISO 18404:2015 Lean Practitioner competencies are listed in Table 1 along with a summary of how each competency can be addressed through a DWO. These competencies are categorised into soft skills (competencies 3, 8, 12 & 13) and hard skills (1, 2, 5 – 7 & 9 -11).

Table 1: DWOs to Address ISO 18404 Lean Competencies

	Competency	DWOs to Address Competency Requirements
1	History & Benefits of Lean	Developing action plans and future state maps after DWOs, balancing workloads in future mapping.
2	Lean Principles	Demonstrating Lean principles during DWOs; engaging teams to show their importance pre- and post-DWO.
3	Stakeholder Management	Going to Gemba for a DWO and debriefing before and after using a combination of ppt, flipchart and the DWO excel sheet
4	Measurement of Process Performance	Capturing cycle times, VA, SA, and W metrics during DWOs.
5	Creative Thinking	Following a DWO during debrief with team
6	Visual Management and Control	Mapping out a DWO and identifying VA, SA and W as well as mapping the constraints and opportunities
7	Workplace Organisation	Could be an output of a DWO
8	Team-based Process Improvement	Engaging team in suggested improvement after a DWO
9	Implementing Lean through a Structured Approach	Writing up a DWO into a A3 improvement sheet, Creating an action plan for the improvements with the team after a DWO
10	Data Analysis	Pie chart of VA, SA and W followed by a pareto of reasons why waste occurs
11	Lean Implementation Risk Analysis	3Cs (Causes, Concerns, Counter measures) with the team before implementing any changes.
12	Sustaining Lean Deployment	Demonstrate how improvements were sustained after a DWO
13	Motivating Others	Recording initial 8 flow and 8 waste discussions with those involved with the DWO, co-creating new shared targets, recognising the team when the improvements were implemented and celebrate improvements

ISO 18404 PORTFOLIO REQUIREMENTS

In terms of Evidence, currently RSS do not provide any guidance on what constitutes suitable/acceptable evidence, but one of the qualified assessors (Ward 2019b) advised that

evidence must be VACS (Valid, Authentic, Current, Sufficient) compliant as follows (National Highways | SMP Alliance, 2025, p. 18-19).

- **Valid** – Can the evidence presented clearly link to the criterion in question. Sometimes with ISO 18404, this may be difficult when different industry sectors are considered. If the candidate is presenting a piece of evidence, and it is not obvious why it meets the criterion in focus, a written annotated explanation of what it's about to clarify the link must be presented.
- **Authentic** – If a piece of evidence is presented, it must show what it has to do with the candidate's personal own work with their name on it.
- **Current** – Evidence presented must be less than five years old and this should be visible.
- **Sufficient** – There should be sufficient authenticated assessment material for the assessor to assess with conviction. When the assessment material is cross-referenced into the assessment standards there should be enough material to meet the standard but should not overload the candidate or the assessor with unnecessary assessment events. For example, one or two pieces of evidence per criterion are enough.

RESEARCH METHODOLOGY

This study focuses on DWOs conducted between 2021 and 2024 in a UK highways alliance project. The Alliance was a 5-year highway upgrade infrastructure framework in the UK and a unique integrated enterprise comprising seven partners, a client, a production management partner, two digitally enabled design partners, and three on-site assembly partners.

Together, these organisations worked collaboratively with over 100 suppliers using the Project 13 Network delivery model (UK alliancing model), along with a programmatic approach and contemporary practices such as digital innovations and off-site manufacturing (Reed-Gibbs, 2024). Project 13 is an industry-led response to improve project delivery that adopts a new business model based on an enterprise (not on traditional transactional arrangements) to boost certainty and productivity in delivery, improve whole life outcomes in operation and support a more sustainable, innovative and highly skilled industry.

A qualitative methodology and single case study design with embedded units of analysis (Yin, 2018) was adopted for the study. Out of 25 DWOs conducted across multiple UK Highways upgrade projects between 2021 and 2024, this study focused on three DWOs as the embedded unit of analysis. These three units of analysis were selected because they involved ISO 18404 candidates that were seeking to develop their portfolio of evidence whilst improving the project workflow. This case study explores how DWOs satisfy ISO 18404 competencies such as engaging with teams and identifying waste. Data was collected using participant observations, time recordings and interviews that were analysed using both thematic analysis for the interview data and content analysis for the observation data. Five semi-structured interviews complemented the observational data, gathering qualitative insights through thematic analysis (Braun & Clarke, 2006) from three ISO 18404 Lean Practitioners, one Lean Leader and one Lean Expert. Drawing on participatory approaches (Aslesen et al., 2023), the interviews explored DWO planning, execution, social constraints and communication, while identifying challenges faced during conducting a DWO. Interviewees reflected on how DWOs supported individual ISO 18404 certification by aiding their portfolio development and coaching of others, highlighting the alignment of DWOs with the technical and behavioural competencies required for certification (Ebbs & Ward, 2024).

The adopted methodology is consistent with previous studies (Seppänen & Görsch, 2022; Koskela, 1999) that have adopted similar methods to draw insights from structured on-site observations capturing quantitative data such as cycle times and semi-structured interviews to

capture qualitative reflections. Structured observation sheets were used to categorise work elements into VA, SA, and W, following the eight wastes outlined by Koskela (1999) and Seppänen and Görsch (2022). Observations also captured improvement suggestions and estimated time savings, providing a foundation for analysing inefficiencies and proposing targeted Lean interventions to improve flow.

THE CASE STUDY – OVERVIEW, RESULTS & DISCUSSION

Between 2021 and 2024, 25 DWOs were conducted as part of the Alliance's Lean Strategy, which aimed for one DWO per project each quarter. Two of the authors hold ISO 18404 Lean Leader and Expert certifications and were involved in eight of the 25 DWOs. They've also supported some of the Lean Practitioners in their development to complete their ISO 18404 certification portfolios. The following three sub-sections of this paper covers the three DWOs selected as units of analysis within the Alliance environment.

DWO 1: CHAMBER & DUCT INSTALLATIONS

In May 2023, two DWOs were conducted over three days to find inefficiencies and suggest ways to improve chamber and duct installation work. The observations were led by an ISO 18404 Lean Leader and two Lean Expert Candidates on route to their certification. They conducted the study to both improve workflow using ISO 18404 soft and hard skills outlined in Table 1, and to use the DWOs as evidence to develop their portfolios. The process followed a clear six-step method, similar to what Oglesby et al. (1989, p. 173) described. It started with understanding the work, planning the study, involving the team, watching the work in real-time, analysing what was found, and finally trying out and applying improvements to make future work better.

On day one, the focus was on getting to know the site and team and planning the DWO. On day two the authors joined the start of shift briefing where they explained the purpose of the DWO (to observe how well management had planned the work). A platter of breakfast sandwiches and the paper aeroplane simulation followed the morning briefing to explain ideas on standardised work, structured continuous improvement and the 8 wastes, and build trust with the team. Figure 1 shows the team during the paper aeroplane simulation.

Figure 1: Site team using paper aeroplane to learn about standardised work and collaboration

The authors emphasized that the DWO was focused on the system and not the person (Prabaharan et al., 2024). This helped the team see the DWO as a support mechanism to expose management and planning deficiencies, not to check on them (Ebbs & Ward, 2024). Lean simulations, such as the paper aeroplane exercise discussed by Rybkowski and Kahler (2014), and National Highways | SMP Alliance (2025, p. 17) provide an effective method to engage construction teams in Lean principles and introduce the concept of DWOs.

The observation followed the simulation. The authors split up to observe chamber and duct installations and calculated the amount of VA, SA, and W using a standard observation sheet. The third day was used to analyse the data, produce value stream maps and output summaries and share the findings with the construction team, pointing out key issues and possible improvements. For example, the results of the chamber installation showed that only 32% of the time was spent on VA work, 26% on SA, and 42% was W. The biggest causes of waste were waiting for materials and equipment, walking long distances to get supplies, and rework because of unclear design details. These problems showed that better make-ready planning was needed, which studies have shown can improve work and reduce waste (Ebbs et al., 2024).

The primary recommendation from these DWOs was to embed make-ready planning. Other recommendations included storing the materials closer to the work area, having daily meetings to improve coordination, and planning work inspections at better times to avoid interruptions. Future state VSMs were prepared, showing that these changes could lead to a 60% improvement in efficiency. A key challenge was ensuring that the improvements were sustained over time. The follow-up observations, conducted after a two-week gap, were crucial to assessing whether the implemented changes were effective. However, the short duration of activities, coupled with the team's commitments to other work zones, made it difficult for them to carry out these follow-ups independently.

DWO 2: Slip Form Concrete Barrier Installation

In June 2024, a DWO was conducted during the installation of a slip form concrete barrier as part of a two-week construction programme. The goal was to identify inefficiencies in the process and suggest improvements to ensure smoother operations. The observation was led by another certified ISO 18404 Lean Leader alongside an ISO 18404 Lean Practitioner Candidate from the supply partner, who was participating in this study to develop his portfolio and use the competencies to improve the process.

From the outset, the project faced several logistical challenges, particularly with concrete deliveries. The batching plant was located a considerable distance from the site, which posed a risk to the timely arrival of materials. The first delivery arrived late, while the second was so delayed that it was out of specification and had to be rejected, resulting in a total delay of over three hours. These setbacks significantly impacted the workflow and underscored the importance of better coordination between the site and suppliers. The analysis showed that of the time available 24% was VA, 14% SA, and 62% was waste.

Despite these challenges, the observation provided valuable insights into improving the process. It was noted that when concrete deliveries arrived on time, the team could achieve the target production rate of 30 meters per hour for slip form concrete barriers. However, due to the earlier disruptions, actual progress was at 13 meters per hour primarily due to delays and inefficiencies in the concrete supply process. Concrete deliveries were coordinated through a central call centre, adding administrative complexity and contributing to disruptions. To improve coordination and reduce delays, it was recommended to establish direct communication with the batching plant and assign a dedicated coordination resource to oversee deliveries and support driver induction. As highlighted by Hamzeh et al. (2016), implementing effective make-ready practices can help remove constraints, enhance workflow reliability, and

ensure that the construction process runs more efficiently, ultimately bridging the gap between current and potential production rates.

DWO 3: COACHING A LEAN PRACTITIONER

In November 2024, a DWO was carried out with two main objectives: first, to analyse the drainage activities on-site and identify any potential inefficiencies using ISO 18404 competencies, and second, to coach an ISO 18404 Lean Practitioner in conducting a DWO as part of their portfolio development, under the guidance of an ISO 18404 certified Lean Leader.

Preparation for the DWO began two weeks in advance. Several meetings were held with the site agent and construction team to introduce the methodology and gain a better understanding of the project's scope. A presentation was delivered to outline the key concepts and steps involved in conducting a DWO. This early engagement helped the team perceive the observation as a collaborative effort rather than an audit, fostering a sense of trust and cooperation (Aslesen et al., 2023).

During the observation, it was found that 32% was VA activities, 6% on SA, while a significant portion of the time 62% was spent on W. All the waste found during the DWO was again due to poor make-ready practices. Issues like unclear design specifications, delays in material deliveries, and unavailable equipment also caused some issues. For example, when the trench shoring support was being removed the side of the shallow trench collapsed prior to backfilling, resulting in rework. This showed that better preparation was needed before starting the work. This is something commonly seen in construction, where not having proper make-ready planning, can slow down progress and affect how smoothly the work flows (Hamzeh et al., 2016); Seppänen & Görsch, 2022).

INSIGHTS FROM INTERVIEWS WITH ISO 18404 PROFESSIONALS

Semi-structured interviews were conducted with five different Lean professionals who conducted DWOs in their assigned projects. The interviewees were three certified ISO 18404 Lean Practitioners, one certified Lean Expert, and one Lean Practitioner Candidate. The interviews explored DWO planning, team engagement, challenges, findings, and the role of DWOs in achieving ISO 18404 certification.

Participant 1: A certified ISO 18404 Lean Practitioner, this participant started the DWO by communicating and asking the team what their key concerns were. They had good relationships established with site teams since they visited work zones regularly. This helped explain that the DWO was supportive (looking at system issues) not evaluative (person/blame issues). The main challenge was restricted and congested work zones that led to a physical restriction to view the process clearly. Another important finding was that engaging with the team early leads to a successful DWO and can help refine workflows through iterative improvements. This participant didn't use DWO evidence for their ISO 18404 portfolio, since their first DWO was conducted after they got certified, however, they used ISO 18404 soft & hard skills in conducting the study.

Participant 2: A certified ISO 18404 Lean Expert. This participant took the time to brief the site team in advance and visit the observation area beforehand. They used Lean simulations such as the paper aeroplane and stickle-brick exercises illustrated in DWO 1 to introduce Lean principles and the 8 wastes. The main challenge faced was the availability of similar work to observe and measure improvement effectiveness. This participant emphasized on the importance of early engagement with the site team using simulations or coaching to get teams buy in. In their ISO 18404 certification, they used coaching and DWO process mapping as soft and hard skills to develop their portfolio.

Participant 3: A certified ISO 18404 Lean Practitioner and a Construction Manager, which helped them identify areas that required improvement. Additionally, their role played a big part in communication with site team based on pre-established relationships, therefore, resistance

was minimal. There were some challenges related to supplier network issues and supply partner's commercial concerns. However, involving the supply partner in the process was key to ensuring buy in and optimising workflows. This participant used DWO evidence for ISO 18404 hard skills competencies, such as takt time and cycle time improvements, and implementing a structured approach to improvement.

Participant 4: An ISO 18404 Lean Practitioner Candidate. This participant coordinated with the senior team to agree on timing and location of the DWO. They attended the start of shift session to gain insights and ensure collaboration. Since most of the activities in this project were short in duration, follow-up observations were difficult to conduct. However, they confirmed that regular make-ready practices, conducted twice a month, significantly improved the work and minimised waste. This participant was 50% towards their ISO 18404 portfolio completion and was planning to include DWO evidence in their portfolio.

Participant 5: A certified ISO 18404 Lean Leader. Their DWO focused on critical path activities and repetitive type of works. They observed these kinds of activities early to maximise impact on project. They started with Lean simulations to engage the team and had regular conversation with them. Challenges arose from improper planning and logistical issues in restricted works zones. Key findings were related to a lack of make-ready practices, which led to traffic management delays and affected supplier readiness which were identified as waste during the DWO. This participant successfully used DWO as part of their Lean improvement projects to meet ISO 18404 Lean Leader competencies.

KEY FINDINGS

- **Planning and Engagement:** Participants highlighted the importance of selecting the right activities for observation, prioritising the activities which are repetitive or on the critical path. Also, early engagement through Lean simulations helped building trust and reduced resistance from construction teams.
- **Challenges:** Common challenges included the limitation on physical presence in active work zones and congested areas, and resistance from on-site teams when DWOs were not clearly communicated as a supportive measure rather than an audit.
- **Make-Ready Practices:** Recurring findings underscored the need for effective make-ready practices to minimize the occurrence of waste and improve the reliability of workflow.
- **ISO 18404 Competencies:** DWOs were instrumental in meeting ISO 18404 competencies, particularly in stakeholder engagement, process improvement, and performance measurement, and at the same time, candidates used these competencies to conduct the DWO more efficiently, ensure smooth communication with the site team and improve workflow.

DISCUSSION

In all the previous studies (e.g., Memarian and Mitropoulos 2012, Neve et al., 2020, Wandahl et al., 2021, Demirkesen et al., 2022, Seppänen and Görsch 2022), practices like DWOs, time and motion studies, first-run studies and work sampling have primarily focused on improving the construction work but not on improving the competencies of the personnel undertaking the observations. The main contribution in this study is the use of DWOs to support Lean competency development and evidencing through portfolio whilst at the same time improving the construction workflow. The evidence from this study has revealed that DWOs can help the observer identify areas of strengths and gaps in their own Lean competencies, evidence where they are competent by collating portfolio evidence for the ISO 18404 requirements and at the same time contribute to improving the construction work on site. The findings also show how

early engagement with the site team through Lean simulations allowed them to understand Lean ideas and how waste affects their daily work (Aslesen et al., 2023). It also helps to reduce resistance and build a collaborative environment. By combining findings from three DWOs and interviews (n=5) with ISO 18404 candidates, this research contributes to the IGLC body of knowledge by showing how DWOs can be used to both improve work processes and support professional development. The results provide recommendations on how to deal with challenges and make the best use of DWOs in construction projects whilst using the ISO 18404 competency framework to plan out how to conduct effective DWOs.

CONCLUSION

DWO is a useful and practical Lean technique that helps reveal what is happening during construction work and engage directly with the people on site. These are the people closest to the work, and they often have the best ideas for practical improvements. Their involvement is not just important for identifying inefficiencies, it also builds trust, encourages teamwork, and strengthens relationships between the team and leadership.

This study suggests a two-step approach to make DWOs more effective. The first observation focuses on identifying the three work elements (VA), (SA), and (W), analysing these to identify wastes and find areas for improvement. The second observation should be conducted after improvements have been made, to check if they are effective and to standardise the new method. This way, DWOs are not just about identifying problems, they become a process for driving measurable, lasting results.

Another important takeaway is the role of make-ready planning. Regular make-ready sessions conducted daily, weekly or monthly, will help teams proactively address potential issues in advance, reduce waste, and improve workflow. These sessions should include everyone involved in the activity, so that everyone can contribute and become ready to work efficiently.

Planning is also a key to get the most out of DWOs. Preparing in advance, using Lean simulations to engage the team and having open discussions before the observation, can help reduce resistance and make everyone more comfortable with the process. Sharing the findings later with senior management not only keeps them informed but also ensures that improvements align with larger organisational goals. Beyond improving workflow and planning, DWOs were a valuable tool for competency development for individuals working towards achieving ISO 18404 certification. By observing actual work on site, candidates were able to use both soft skills for clearer communication and hard skills to improve the processes. By doing so, they were able to use these skills as evidence for their portfolio development while also contributing to improvements.

REFERENCES

Aslesen, S., Hindenes, A., Reff, S., Stordal, E., & Lombardo, S. (2023). Green is good: First run study of a sustainable building structure. *Proceedings of the 31st Annual Conference of the International Group for Lean Construction (IGLC31)*, (pp. 521–530). http://doi.org/10.24928/2023/0228

Ballard, G. (2000). The Last Planner System of Production Control. University of Birmingham, UK.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*, 77–101. https:/doi:10.1191/1478088706qp063oa

Demirkesen, S., Sadikoglu, E., & Jayamanne, E. (2022). Investigating effectiveness of time studies in Lean construction projects: case of Transbay Block 8. *Production planning & control*. *33*(13), 1283-1303. doi.org/10.1080/09537287.2020.1859151

Ebbs, P. J., & Ward, S. A. (2024). ISO 18404: A Model for Lean Transformation in an Alliance. In D. B. Costa, F. Drevland, & L. Florez-Perez (Eds.). *Proceedings of the 32nd Annual Conference of the International Group for Lean Construction (IGLC32),* (pp. 1255–1267). doi.org/10.24928/2024/0225

Evans, M., Farrell, P., Elbeltagi, E., & Dion, H. (2022). Competency framework to integrate Lean construction and integrated project delivery on construction megaprojects: towards a future of work global initiatives in multinational engineering organisations. *Benchmarking: An International Journal, 29*(6), 1913-1956. doi.org/0.1108/BIJ-02-2021-0066

Gilbreth, F. B. (1909). *Bricklaying System.* The Myron C. Clark Publishing Co., New York.

Hamzeh, F., Zankoul, E., & Sakka, F. E. (2016). Removing constraints to make tasks ready in weekly work plan. *Creative Construction Conference, Procedia Engineering,* 164, 68–74. doi.org/10.1016/j.proeng.2016.11.593

Harada, T. (2015). *Management Lessons from Taiichi Ohno: What Every Leader Can Learn from the Man Who Invented the Toyota Production System.* McGraw-Hill Education.

International Organization for Standardization. (2015). Quantitative Methods in Process Improvement - Six Sigma - Competencies for Key Personnel and Their Organizations in Relation to Six Sigma and Lean (ISO Standard No. 18404:2015). https://www.iso.org/standard/62405.html

Kpamma, Z. E., Nsia, E. A., & Agyema, S. (2014). How Aligned Is the Competency-Based Training Model with the Lean Philosophy? *Proceedings of the 22nd Annual Conference of the International Group for Lean Construction (IGLC22),* (pp. 25-27).

Koskela, L. (1999). Management of production in construction: A theoretical view. *Proceedings of the 7th Annual Conference of the International Group for Lean Construction (IGLC7)*, (pp. 241–252).

Memarian, B., & Mitropoulos, P. (2012). Production control and workflow reliability in construction. *Proceedings of the 20th Annual Conference of the International Group for Lean Construction (IGLC20)*, (pp. 671–680).

National Highways | SMP Alliance. (2025). Alliance Lean Production System (ALPS) Playbook: our guide to successfully embedding a culture of sustainable continuous improvement on infrastructure projects. https://online.flippingbook.com/view/720236703/

Neve, H. H., Wandahl, S., Lindhard, S., Teizer, J., & Lerche, J. (2020). Determining the relationship between direct work and construction labor productivity in North America: Four decades of insights. *Journal of Construction Engineering and Management, 146*(9), 04020110. https://doi.org/10.1061/(ASCE)CO.1943-7862.00018

Ohno, T. (1988). *Toyota Production System: Beyond Large-Scale Production.* CRC Press.

Oglesby, C. H., Parker, H. W., & Howell, G. A. (1989). *Productivity Improvement in Construction.* McGraw-Hill Series in Engineering and Project Management. New York.

Prabaharan, R. , Devkar, G. , Rybkowski, Z. K. & Kannimuthu, M. 2024. The Repair-Co Game: A Roadmap to Demonstrate the Importance of Problem-Solving Capabilities of Lean Tools. *Proceedings of the 32nd Annual Conference of the International Group for Lean Construction (IGLC 32)*, (pp. 1303-1313). doi.org/10.24928/2024/0211

Reed-Gibbs, A. (May, 2024). *Project 13 early adopter case study: SMP Alliance.* https://www.project13.info/news/project-13-early-adopter-case-study-smp-alliance-r65/

Rybkowski, Z., & Kahler, J. (2014). Collective Kaizen and Standardization: The development and testing of a new Lean simulation. *Proceedings of the 22nd Annual Conference of the International Group for Lean Construction (IGLC22)*, 675–686.

Seppänen, O., & Görsch, C. (2022). Value-adding index: Share of direct work included in uninterrupted presence time. *Proceedings of the 30th Annual Conference of the International Group for Lean Construction (IGLC30)*, (pp. 130–141). doi.org/10.24928/2022/0115

Taylor, F. W. (1911). *The Principles of Scientific Management.* Harper & Brothers.

Wandahl, S., Neve, H. H. & Lerche, J. (2021). What a Waste of Time, *Proc. 29th Annual Conference of the International Group for Lean Construction (IGLC), (pp.* 157-166). doi.org/10.24928/2021/0115

Ward, S. (2019a). *Piloting the Deployment of ISO 18404 in the Construction Sector: Project Report.* Construction Industry Training Board. https://leanconstruct.co.uk/wp-content/uploads/2023/02/18404-case-study.pdf

Ward, S. (2019b). *ISO 18404 Portfolio Guidelines.* Unpublished

Ward, S. A. & Caklais, S. (2019). Piloting the Deployment of ISO 18404 in the Construction Sector, an Approach to Organisational Transformation. *Proc. 27th Annual Conference of the International Group for Lean Construction (IGLC)*, (pp. 203-214). doi.org/10.24928/2019/0174.

Yin, R., K. (2018). *Case Study Research*. 5th Ed. Sage. CA