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SCRUM COMPLEMENTING LAST PLANNER SYSTEM – A CASE STUDY

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ABSTRACT

Scrum emerged from the software sector and has been identified as a novel methodology that is radically different from traditional project management teaching. However, there is a paucity of data from real life case studies that affirm Scrum can benefit construction execution.

This paper reports on a 20-week Scrum implementation across seven teams on a construction project that must achieve a critical building weathertight milestone. The study adopted a mixed-methods approach utilising case study design and data collected from a literature review, project documentation review, direct observation, purposeful semi-structured interviews, and a focus group workshop.

Scrum complements Last Planner® System (LPS) implementations and brings specific benefits at point of work execution by reducing weekly missed tasks resulting in increased and more reliable Planned Percent Complete (PPC). An 11 percent increase in average PPC accrued from utilising Scrum to complement LPS by reducing reasons for non-completion (RNC) of work tasks at crew level work interfaces. Additional softer benefits in the form of enhanced inter-trade communications and collaboration, as well as greater involvement of the entire crew in striving to achieve task execution. Further in-practice and academic research is required in aligning construction processes and methodologies with the concepts and definitions found in Scrum.

KEYWORDS

Lean construction, agile, scrum, last planner system, collaboration.

INTRODUCTION AND LITERATURE REVIEW

The basis of Lean thinking is the understanding and design of production processes (Koskela 1992, 2000) and Rooke (2020) asserts these processes depend on people to make them happen. While early Lean literature may have overly focused on the 'hard' tools and techniques at the expense of the 'softer' behavioural aspects (Hines et al. 2020), LC brings a balanced view of both people and production process into construction (Rooke 2020).

The LC community has consistently sought learnings from other business sectors with a view towards enhancing construction's performance. As early as 2002 Koskela and Howell expanded their earlier work on the theoretical foundations of project management

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and referred to two innovative methodologies that were a radical change from the existing teaching of project management. These were LPS and Scrum (Koskela and Howell, 2002a, p.2). LPS was developed as a collection of functions that assist practitioners coordinate production operations on construction projects (Ballard and Howell 2003; Hamzeh et al. 2016; Power et al. 2021). LPS has since become a dedicated and foundational tool of LC and applies the fundamentals of Lean thinking to construction planning and execution (Ballard and Tommelein, 2020). Meanwhile, at the same time (early 1990's) Jeff Sutherland and Ken Schwaber were creating Scrum '…as a faster, more reliable, and more effective way to create software in the tech industry' (Sutherland, 2014, p. vii). Koskela and Howell (2002a) identified Scrum as being a comprehensive management method that skipped over conventional project management doctrine and suggested the success of Scrum and LPS theories offered substantial improvement on the traditional theory of project management as espoused in PMBOK.

Case studies have established that Scrum can enhance design coordination (Kalsaas et al. 2014; Lia et al. 2014; Demir and Theis 2016), collaboration in planning (Daniel et al. 2020), and management of construction projects in a multi-project environment (Hamerski et al. 2019). While LPS has also thrived in design, management, and support functions there is a paucity of tangible data to demonstrate the benefits Scrum can bring to construction execution. This paper examines the use of Scrum in construction and offers findings and recommendations from a case study conducted on a construction project.

SCRUM

The Scrum Guide (2020) describes Scrum as: '…a lightweight framework that helps people, teams and organisations generate value through adaptive solutions for complex problems.' A key characteristic is the autonomous team which is empowered to make relevant decisions to achieve its goals. Work is carried out in time-boxed 'sprints' that empower teams to examine progress and adjust if required, thus minimising risk of miscommunication or over-processing tasks (Sutherland 2014; Layton et al. 2020; Engineer-Manriquez 2021). Scrum requires a Scrum Master (SM) to create a working environment where a Product Owner (PO) organises the work to be completed into a Product Backlog; the Scrum Team works on prioritised tasks converting them into increments of value during a Sprint; and the Team and its stakeholders inspect the results and adjust (continuously improve) for the next Sprint (Sutherland, 2014). Scrum relies on the deep tacit knowledge of its team members to rapidly address work batches and continuously release increments of value to the next customers in line (Owen et al. 2006). The Scrum framework is purposefully incomplete and is a radical change from the traditional prescriptive management methodologies; rather than provide people with detailed instructions, the rules of Scrum guide persons relationships and interactions (Schwaber and Beedle 2002; Scrum Guide 2020).

SCRUM THEORY – RELEVANCE IN CONSTRUCTION

Agile processes are based on an empirical control method – a process of making decisions based on the realities observed on the project (Layton et al. 2020). Action follows from each situation created by prior action. This is labelled 'management-as-organising' by Koskela and Howell (2002a, p.8), but in a 'lightweight manner' as described by Owen et al. (2006, p.54). Table 1 summarises Koskela and Howell's (2002a) work on interpreting the theory underpinning Scrum.

Table 1: Underlying Scrum theory (from Koskela and Howell 2002a)

Theory	Explanation
Planning	Management-as-Planning: High level to develop Backlog of Value to be delivered; Sprint planning cycle & Daily review cycle. Management-as-Organising: Pre-determined work cycles and conversation routines. Action created from prior action & coordinated within the Team. Management is addressing the structuring of the setting of action, in terms of predetermined work cycles and associated, routinised conversations.
Execution	Pull from Backlog; self-assign tasks; deliver regular Value in Sprints; Team self-inspects and adapts; the whole Team is the customer of the task.
Control	Three levels of control exist: 1. Highlight & escalate impediments / blockers for resolution (based on scientific experimentation model – focuses on learning & knowledge creation). 2. Completed Sprint offered to Customer & Management (based on scientific experimentation model – focuses on learning & knowledge creation). 3. Refine and readjust Product Backlog prior to next Sprint (based on thermostat model – manages time & cost issues).

Critically, Scrum is different from traditional project management teaching as it does not have a Work Breakdown Structure (WBS) and task dispatching decisions are decentralised from management to the team (Koskela and Howell 2002a). The Customer and management determine the value and features required by creating a Product Backlog and Scrums planning theory allows the Team to self-organise work in sequential Sprints. Scrum's execution theory pulls from a Product Backlog of customer requirements. Self-organising teams of three to nine persons self-assign tasks that are sized to deliver value at a regular cadence called Sprints. Scrum uses frequent and first-hand inspection of the work where teams can make immediate adjustments coordinated by its members as opposed to the traditional management methodology of centralised management (Chen et al. 2007; Sutherland 2014; Layton et al. 2020). Control theory in Scrum exists at three levels according to Koskela and Howell (2002a). At the lowest level each team member highlights impediments to task execution and escalates these to higher levels for resolution. At the next level the team presents its completed Sprint achievements to both management and customer, exhibiting both value and functionality offered to the project. Feedback and continuous improvement are incorporated into the next Sprint. The highest control level in Scrum concerns the entire project where the Product Backlog is refined and overall project control relating to cost, scope and schedule is revised and reimagined as required (Koskela and Howell 2002a; Sutherland 2014; Layton et al. 2020). The key concept of agile thinking and the Scrum framework is the constant focus on value identification, value generation, and value delivery (Sutherland 2014; Layton et al. 2020; Engineer-Manriquez 2021). Agile theory and the Scrum framework closely align with the primary lean aim of providing value throughout the delivery process as opposed to traditional construction and project management which, from the start, focuses on clearly defined value outcomes defined as project deliverables (Owen et al. 2006).

SCRUM IN CONSTRUCTION

Since the potential of Scrum for construction was first highlighted by Koskela and Howell (2002a), there is a lack of published studies relating to Scrum application in the construction sector. Owen et al. (2006) suggested agile project management can relate to construction but highlighted several obstacles to its adoption. Numerous authors admit Scrum is more easily applicable to design (Owen and Koskela 2006; Chen et al. 2007; Kalsaas et al. 2014; Demir and Theis, 2016) and others (Bertelsen, 2002; Bertelsen and Koskela 2003) add that constructions rigid assembly sequence plus its complexity, means change and reworks are difficult to accommodate in construction. Conceptually, design in construction and software development are similar in their iterative character as regular increments of work (value) can elicit feedback until client satisfaction is achieved (Kalsaas et al. 2014; Demir and Theis 2016). These feedback loops and the ability to inspect and frequently adapt to feedback and change are core to the Scrum framework (Sutherland 2014). Some implementations have complemented LPS in design with Scrum sprints enhancing the execution phase (Lia et al. 2014; Kalsaas et al. 2014).

The current approach to planning in traditional construction project management is mostly limited to the transformation of inputs to outputs (Sacks et al. 2016; Daniel et al. 2020); numerous authors agree this cannot enable the collaboration and social network structure required for effective and timely task execution (Demir and Theis 2016; Power and Taylor 2019; Ballard et al. 2020). However, according to Daniel et al. (2020), the 'flow' and 'value' views offered by LPS and Scrum can provide the resources required for smooth running of a collaborative construction production system. Additionally, the structure and process of both LPS (short term planning, execution and control – Koskela and Howell, 2002a, p.6) and Scrum (focusing on Minimum Viable Product through Sprints – Layton et al. 2020, p.438) completes the 'transformation' of inputs to value outcomes.

SCRUM AND LPS COMMONALITIES

Researchers and practitioners should recognise that LPS was specifically designed as a system for planning and controlling production on projects and extended to '…both production (i.e., striving for targets) and project planning and control (i.e., setting targets) in the 2020 Current Process Benchmark (Ballard and Tommelein 2021). Scrum is a subset of Agile, has its roots in lean and in Deming's PDCA (Sutherland, 2014), and according to Poudel et al. (2020) LPS and Scrum share several principles relating to team collaboration in both work organisation and enhancing customer value. Suggested commonalties from Poudel et al. (2020) and Engineer-Manriquez (2021) are: a) both are frameworks designed to increase value delivered to the customer by pulling increments of value adding work into progress while also protecting team capacity by limiting work in progress, b) both use different planning levels to break down and coordinate activities, c) both emphasise systematic learning and continuous improvement, d) LPS master and phase schedules are similar to the Scrum Product Backlog, the constraints concept is common to both, and LPS weekly work plan is equivalent to the Scrum Sprint Backlog, e) both require consistent team collaboration to refine planning and daily coordination and this is managed with scheduled events, f) both use metrics to track progress and performance.

METHODOLOGY

CASE PROJECT

The case project is in Ireland and is an extension to a distribution warehouse for an international manufacturer. The building is 12,000 m^2 in floor area, is 15m high, and has

28 dock leveller truck loading bays on opposing elevations. The building is steel portal frame on concrete pad foundations with elevation and roof cladding panels. A major ground works enabling project plus substantial works at the 100m interface with the existing facility adds to the overall complexity of the project. The initial key objective is to achieve a handover milestone date for the finished floor space to enable the racking installation provider to gain early access. The project was 26 weeks in progress, had 20 weeks remaining until the key interim handover milestone, and was already three weeks late due adverse weather affecting the soil stabilisation works. The schedule was re-baselined with a commitment to recover the three weeks slippage and retain the original interim milestone date. Therefore, the problem to be addressed was to steer the project towards achieving agreed Conditions of Satisfaction (CoS) relating to the early-access milestone. Additionally, the Project Director was concerned of over-runs in the remaining schedule duration as there were substantial financial penalties for not achieving the milestone.

RESEARCH DESIGN

The paper reports on a case study of Main Contractor implementing Scrum to achieve a critical milestone on a construction project which was running three weeks behind programme. The team had been using LPS but were still experiencing problems at crew level relating to coordination and workface organisation. This study utilises a mixed-methods approach with case study design in accordance with Yin (2009). Case study is a widely used research design and according to Yin (2013) is best placed to answer 'how' and 'why' questions. Principles of action research and learning were also applied as the researcher was coaching the project team during a critical phase of the project. Figure 1 presents the layout of the Scrum framework utilised on the project.

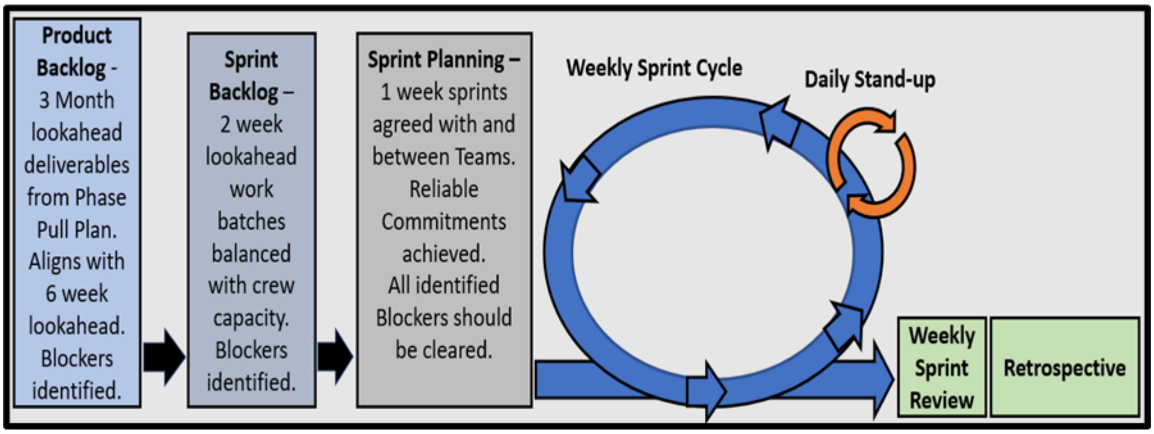

Figure 1: Scrum framework implemented on the case project.

The framework presented in figure 1 aligns with the conceptual model presented by the founders of Scrum, and as described by Sutherland (2014), Layton et al. (2020) and Engineer-Manriquez (2021). A key input is the LPS functions of Pull Planning, Lookahead Planning, including early constraints identification (called blockers on this project), to prepare the prioritised Backlog of tasks for the work crews to plan from.

Purposefully selected interviewees were familiar with construction and participated on the project. An external Agile coach/Certified Scrum practitioner was invited to observe the implementation and his feedback was also included in the research data. In accordance with Braun and Clarke (2006) the transcribed interviews were thematically analysed; triangulation was ensured when conclusions reached from emerging themes were compared with workspace board outcomes and the literature review findings to check their reliability and integrity. In accordance with Eden and Huxham (1996) an action research approach was utilised to monitor and measure the effectiveness of interventions. An integrative literature appraisal examined existing Lean, Agile, Scrum, and LC literature. Seven virtual workspace planner boards from the contractors critical to achieving the milestone (Roofing, Cladding, Precast, Dock Enclosures, Groundworks, Flooring, Core Team and Blocker) were examined for level of task detail and alignment with milestone targets.

On achievement of the milestone, a focus group workshop was conducted with the site management team and key contractor supervisors. Purposeful semi-structured interviews were conducted with six senior figures on the project. LPS Pull Plans, Weekly Work Plans, and PPC data was also available to the researchers. Table 1 presents the data sources for the research.

Table 1: Research Data Source

Source	Participants
Integrative Literature Review	Lean, Agile, Scrum, LC Literature & particular focus on past IGLC contributions
Project Documentation	Project schedules, “S” curves, Weekly reports, Seven virtual workspace planner boards, LPS PPC & RNC data.
Direct Observation	Action Research Diary
Purposeful Interviews	Interviews with Contractor Director, Project Manager, Client Representative, Roofing Contracts Manager, Precast Installation Director, External Agile coach / Scrum practitioner. (n=6)
Focus Group Workshop	A facilitated focus group workshop was conducted with team members and key sub-contractors (Roofing, Cladding, Precast, Groundworks, Dock Enclosures, Flooring) on achievement of the milestone.

Limitations exist around the single case example, the small sample size, and the limited sample profile.

FINDINGS & DISCUSSION

LPS data

The team had been using LPS and PPC was averaging 72 percent for the first 26 weeks of the project. This included four weeks of persistent rainfall which caused three weeks slippage in the schedule. The impact of the exceptional rainfall caused a 4 percent drop in average PPC; excepting these outlier 4 weeks gives an average 76 percent PPC over the first 26 weeks. In addition to weather impact, examination of the RNC data pointed to tasks over-running due to inter-trade communication and coordination issues at point of work interfaces.

Defining the problem

Root cause analysis investigation found crew leaders were attending LPS morning huddles, but communications were not relayed to all team members, especially relating to handovers to other trades. Preparing for the flooring contractors’ arrival to site would involve critical interface coordination. Therefore, a more detailed communication strategy that involved crew members from all teams focusing on priority handoffs would be required.

Conditions of Satisfaction

Understanding exactly what was required to satisfy the key milestone needed to be understood by all stakeholders in the process. The racking installer provider required a clear floor area available as they had multiple installation crews assembling different racking systems simultaneously. The building also needed to be weather tight. The flooring contractor required 4 weeks installation duration, requested 50% of the floor area to be available, and needed the space to be wind and rain-proof. A process mapping exercise reduced this request to 33% of the floor area. However, detailed daily coordination of the key contractors would be required to seal the building envelope to align with the partial handovers for the flooring contractor.

Why Scrum?

Scrum had been used in the design phase of the project and management noted the daily huddles involving the workers in the teams as opposed to just the team leaders. An After-Action-Review (AAR) post-design phase identified the connectivity created at team level as a key advantage of Scrum over the crew supervisor-level engagement of LPS. Additionally, examination of the RNC on the weekly LPS implementation illustrated a trend of missed tasks accruing from incomplete or late handoffs and poor interface coordination at crew level. Chen et al. (2007) figure 1b, had proposed '…small, interactive multi-disciplinary teams… absolutely self-managing' (p.63), illustrating a model which assured communication saturation amongst Teams. For these reasons the Project Director requested Scrum concepts be implemented in conjunction with the LPS implementation.

Team level communication

Individual teams communicated directly with each other and any issue unresolvable at site crew level was immediately escalated by the SMs to the Core Team / Blocker Board. A key finding was the amount of rapid decision-making enabled on the site thus minimising escalation to management and subsequent waiting for responses. The SMs played a critical role in ensuring the path ahead was always clear to allow the team to achieve steady flow and consistent production outputs. The Product Owner (PO) of the onsite teams was the Project Manager (PM) and the Project Director was PO for the Core Team / Blocker Resolution Board. Each team was assigned a SM with junior PM #1 supporting and serving Cladding, Roofing, and Precast teams. Junior PM #2 supported and served the Ground Works, Floor Install, and Dock Enclosures as SM. The lead author served the Core Team / Blocker Board as SM. All POs and SMs received Scrum training and certification. Effectively, the SMs became facilitators of conversations within and between the site teams ensuring daily and weekly planning interfaces were constantly to the forefront. All Team members received introductory Scrum training explaining their roles and the objectives of the implementation.

Daily routine

Critical also to success was the importance of routine; figure 2 illustrates the weekly Scrum cycle noting the demand on the work crews is only 10 minutes for the daily stand up at the same time each day.

Scrum Weekly Cycle				
Mon	**Tue**	**Wed**	**Thur**	**Fri**
Team Daily Stand-up (Pre-0900)	Team Daily Stand-up (Pre-0900)	Team Daily Stand-up (Pre-0900)	Team Daily Stand-up (Pre-0900)	Team Daily Stand-up (Pre-0900)
Scrum Masters & Project Manager Stand up (1020-1030)	Scrum Masters & Project Manager Stand up (1020-1030)	Scrum Masters & Project Manager Stand up (1020-1030)	Scrum Masters & Project Manager Stand up (1020-1030)	Scrum Masters & Project Manager Stand up (1020-1030)
Core Team / Blocker Board Touchpoint (1335-1345)	Core Team / Blocker Board Touchpoint (1335-1345)	Core Team / Blocker Board Touchpoint (1335-1345)	Core Team / Blocker Board Touchpoint (1335-1345)	Core Team / Blocker Board Touchpoint (1335-1345)
		Sprint Planning (1630-1700)	Sprint Planning (1630-1700)	Sprints Review (1500-1515)

Figure 2: Scrum implementation weekly cycle

The importance of routine and a rapid blocker escalation and resolution process were critical to the success of the implementation. Each crew's stand up would take place at the same time daily. On the case project, each SM had to support three teams so they would schedule the individual stand-ups at 0745, 0815, and 0845. The key point was each stand up was conducted before 0900. The SMs and the PO had their stand up at 1020, just after their morning break. This ensured communication saturation early in the day – the site management team were aware of any issues or concerns that may affect performance.

Complementing LPS

In LPS it is generally the crew leader who attends the morning huddle however, in the Scrum stand-ups on the case project every crew member had a voice, and this was a critical aspect in empowering everyone to contribute. Simple issues like diminishing supply of screw fixings, anticipated specialist equipment requirements, or advance notice of a member needing a day off were communicated. Figure 3 presents PPC figures for 26 weeks with LPS and for the following 20 weeks with Scrum complementing the LPS functions. PPC over the first 26 weeks shows the impact of excessive rainfall on the soil stabilisation and foundation installation activities with sub-60 percent figures for three consecutive weeks (6 to 10). However, PPC was still struggling to consistently achieve reliable 80 percent weekly. Scrum complemented the LPS at crew level daily interfaces and average PPC from week 27 to week 46 was 87 percent; this was an 11 percent PPC increase from the first 26 weeks adjusted average PPC. Comparison of RNC from post-week 27 data (Scrum) with pre-week 27 data (without Scrum) points to a reduction in scheduling and coordination issues at interface handoffs between crews. Table 3 points to tangible PPC improvement from the introduction of Scrum and suggests PPC may have remained below 80% weekly if Scrum had not been introduced.

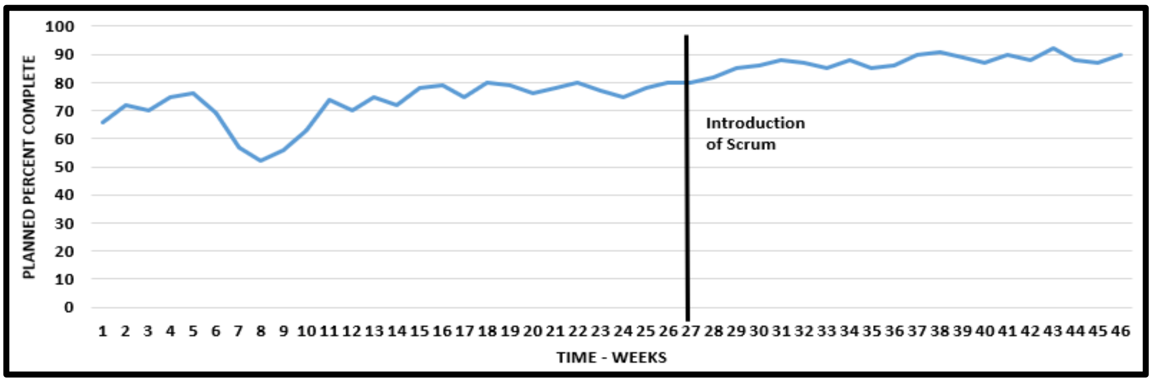

Figure 3: Impact of Scrum on PPC

It is important to note that the functions of LPS were essential towards establishing the Pull Plan, identifying constraints at multiple levels, consistently preparing for flow, stabilising the lookahead, and aligning the Product Backlog, Sprint Backlog, and Sprint Planning with the lead-in to preparing a weekly work plan. Site management and crew supervisors still attended the LPS huddles and planning sessions and PPC was recorded weekly.

Scrum Master role

With everyone involved there is less waste relaying communications and less chance of misunderstanding. Notably, the SM, even though a member of the site management team, was equal in status to all other team members in the Scrum teams. SMs must work as both coaches and facilitators (Layton et al. 2020) and this was a critical role for the SMs on the case project. SMs shielding the Team from external distractions or demands as well as maintaining focus on the Sprint was of immense benefit according to the interviewees. A summary of the interview themes and findings are summarised in table 2.

Table 2: Interview findings

Theme	Comment
Communication	Entire crew involved in daily stand up. Communications channelled to SM & PO stand up & to Core Team / Blocker Board Touch point & rapidly back to Team at next stand up. Better site interactions, communications & knowledge sharing.
Team autonomy	Team felt they were not being directed by management with constantly changing objectives & deadlines. Once a Sprint was set, the Team was free to deliver in the best way they decided.
Consistency in planning	Routine brought by the process brought consistency to the week and month.
Team Spirit	Limitation of work in progress, allied to external impediment removal protected the Team from unnecessary stresses. SMs shielding the Team from external distractions or demands as well as maintaining focus on the Sprint protected Team capacity and focused on the goal. This fostered a collaborative, innovative, and proactive culture making the project a ‘happier’ place to work.
Continuous improvement	Due to the small-sized teams (largest Team had eight members) there was continual and focused interest & motivation in improving the process.

Blocker identification and removal

The focus group workshop findings suggest more detailed interface planning effort at site level, particularly coordination by the SMs, ensured smoother workflow and less reactionary planning at the workfaces. When issues arose, there was a process in place to ensure rapid escalation and resolution of the issues. The findings from this facilitated focus group workshop are presented in table 3.

Table 3: Focus group workshop findings

Theme	Summary
Weekly planning	Clarification of priorities & alignment with other trades ensured clear focus for the upcoming week.
Short cycles	Breaking the work into smaller batches ensured more frequent hand-offs of value to the next trade in line.
Removing blockers	SMs helping identify blockers & then taking the blocker for resolution took stress off the Team
Engagement & involvement	Entire Team involvement in the Stand-up huddles generated more information and assisted with focus & alignment.
Ensuring next work area is available	With SMs interacting between Teams there was greater reliability in ensuring the next areas and handoffs were available.
Completion of work & quality	SMs encouraged completion of increments that delivered value handoffs to next trades in line. No multi-tasking. Focus on the quality handoff.

After time, a climate of greater inter-trade agreement and alignment on achieving schedule dates emerged. Teams became more pro-active in foreseeing potential blockers and took positive action for the betterment of the project and other trades progress. A tangible benefit of the implementation was the improved quality of the completed work elements to the next trades. Trades working closer together created relationships and with that a responsibility not to pass on defective work. Work being broken into smaller batches resulted in shorter turnover cycles and resultingly brought improvement to the schedule duration as there was less work in progress and less waiting time.

Clarity and agreement of the definition of 'Done' ensured greater alignment between Teams. Where Chen et al. (2007) suggested some lean and agile applications increase project complexity, this study asserts effective Scrum implementations utilising small, autonomous, self-performing teams, served, and facilitated by focused SMs can enhance interface management and simplify daily and weekly production.

CONCLUSION & RECOMMENDATIONS

The schedule early access milestone was achieved however, the authors do not claim this was solely due to the Scrum implementation. The study illustrates how Scrum could be implemented on a construction project and presents examples of the benefits that accrued from this specific implementation. The fact that the Main Contractor and sub-contractors decided to continue the Scrum framework into the next stages of the project suggests advantages have accrued to all parties. While acknowledging that a mature LPS implementation would possibly have achieved similar results, the authors question if LPS would have reached the required level of maturity as quickly as the Scrum process. Additionally, we posit an issue for current LPS implementations is the dissemination of information from crew leaders to crew members; on many large projects it is usually only crew leaders attend huddles and planning sessions. Within the Scrum framework everyone is involved in planning and execution thus extending LPS to every individual as opposed to just every crew leader. We suggest introducing Scrum was easier as the implementation involved individual Teams; this would have been closer to the traditional siloed models inherent in construction and not such a culture shock as some of the instantaneous collaboration demanded by LPS. Therefore, the cultural change demanded was not huge and, in fact Scrum satisfies Team members intrinsic desire for involvement. Critically, adding the services of the SMs as a facilitator, coach, roadblock remover, coordinator, planner, liaison with other contractors, and servant leader brought extra support to individual Teams and to the overall site coordination and was a key enabler of improvement and success. Additionally, the Main Contractor's management process became smoother as the two SMs were embedded within the production teams and then liaising cyclically with the PM and the Project Director. Working with smaller increments ensured greater quality control and visibility of the true status of project progress. The authors acknowledge this was a simple and straight forward implementation on the structure and envelope of a project superstructure. Next steps would be to carry the process through services installation and commissioning.

Finally, further practical, and academic research is required in aligning construction processes and methodologies with the concepts and definitions found in Scrum.

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