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Decentralising Flow Conversations: Improving Productivity through Collaboration with Site Operatives

Emmanuel Manu

Ani Raiden

Emamode Eyituoyo Akwerigbe

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Emmanuel Manu, emmanuel.manu@ntu.ac.uk
School of Architecture, Design and the Built Environment, Nottingham Trent University, U.K

Ani Raiden, ani.raiden@ntu.ac.uk
Nottingham Business School, Nottingham Trent University, U.K.,

Emamode Akwerigbe, emamode.akwerigbe@ntu.ac.uk
School of Architecture, Design and the Built Environment, Nottingham Trent University, U.K

Abstract

Low productivity remains a persistent challenge in the construction industry, often stemming from fragmented workflows, poor integration, and collaboration across the supply chain. This study aimed to investigate how site operatives can be actively engaged in identifying and resolving constraints to site workflow through a structured collaborative practice using the eight-flow model as a framework. The study adopts an Ethnographic Action Research (EAR) methodology, encompassing three iterative stages—observation, action, and reflection. EAR was applied through 3 rounds of workshops with 30 site operatives on a live construction site in the UK focusing on collaborative risk management using a flow activity. Data was collected using observation notes, the output of the flow activity and post-workshop feedback comments and analysed using content analysis. Findings reveal that constraints relating to information, materials, and equipment flows were often compounded by poor communication, unrealistic programming, and inefficiencies in material logistics, while collaboration with site operatives is central to success. By embedding site operatives into flow conversations, the study emphasises the transformative potential of leveraging the expertise and insights of operatives at the workface to address workflow inefficiencies and improve productivity. As a wider implication, tools like WhatsApp and site-level flow task boards were suggested as potential platforms for ongoing engagements with site operatives in conversations about flow on the site using the eight-flow model. Further research is needed to embed flow conversations as part of standard practice, through toolbox meetings and daily hurdles, to create a culture of proactive engagement that fosters shared understanding.

Keywords: construction industry, flow, productivity, site operatives

1 Introduction

The low productivity in the construction industry remains an ongoing challenge (Konstantinou and Brilakis 2019). This low productivity is often rooted in fragmentation, poor integration, and adversarial stakeholder relationships in construction (Nawi et al., 2014). These systemic issues undermine effective collaboration and hinder the achievement of project objectives (Daniel et al., 2020). To address productivity challenges, innovative approaches like make-ready planning, a cornerstone of the Last Planner System (LPS), have emerged and have been promoted amongst the lean construction community (Porwal et al., 2010; Lagos et al., 2023). Make-ready planning aims to enhance workflow reliability by proactively identifying and addressing constraints before execution (Ebbs and Pasquire, 2018). Ebbs and Pasquire (2018) developed the "flow walk" process, which is systematically used to engage construction project stakeholders in identifying constraints across eight key workflow categories: information, equipment, materials, prior work, people, safe space, external conditions, and shared understanding. While this methodology has been demonstrated as effective for improving make-ready planning among project teams (Ebbs and Pasquire 2018, Ebbs et al 2024), its success hinges on the inclusion of all relevant actors. However, the critical role of frontline site operatives—those directly involved at the workface undertaking site installations — remains underexplored in existing studies. The “flow walk” process has largely been tested with project teams at the site management level and questions remain as to how site operatives can be fully engaged in structured conversations and collaboration aimed at improving site workflow. To bridge this gap, this study sought to investigate how site operatives contribute to a structured activity on improving flow and productivity on site using a flow walk activity, thereby enhancing make-ready planning and addressing site-level constraints. The guiding research question is: How can site operatives contribute to identifying and resolving site workflow disruptions using the “flow walk” process?

The rest of the study provides a review of the literature on how a focus on improving flow can contribute to productivity on site, followed by the methodology adopted in the study, the findings and discussion and finally the conclusions of the study.

2 Flow and Productivity in Construction

The concept of flow has been a cornerstone of lean construction, originating in Koskela’s Transformation Flow Value (TFV) theory, which has been argued to promote a holistic perspective on project processes (Biton & Howell, 2013). Koskela (2000) challenged the construction industry's narrow focus on maximising resource utilisation, arguing that such an approach often undermines project coherence. While flow is conceptually appealing, its lack of a precise operational definition has posed challenges for practical implementation. Traditionally, the lean construction perspective has centred on production, emphasising waste reduction and task control (Salvatierra-Garrido et al., 2012). Although effective in addressing technical inefficiencies, this approach arguably overlooks the vital socio-technical dimensions of construction. Scholars now recognise the importance of human factors, such as collaboration and communication, in achieving project success (Pasquire and Court, 2013). This shift has led to a broader understanding of flow, incorporating both technical and relational dynamics. Flow, as a concept, has evolved from a simplistic transformation model to a multifaceted framework encompassing material, information, and human factors (Slivon et al., 2010). Tommelein et al. (2022) further expanded this understanding, demonstrating how flow operates across multiple dimensions, from the movement of physical resources to intangible aspects like communication.

2.1 The Eight-Flow Model in Lean Construction

Bertelsen *et al* (2007) proposed a seven-flow model based on the pre-conditions for construction work to progress without delay as: information, materials, crew (people), space, equipment, previous work, and external conditions. Pasquire (2012) proposed the addition of shared understanding as an eighth flow, which expands the scope of lean construction to address constraints holistically. This model integrates technical, human, and environmental factors, offering a comprehensive approach to improving project outcomes (Ebbs and Pasquire, 2018). Each flow constraint within the model highlights a distinct requirement for construction project success. Information flow ensures stakeholders receive timely and accurate information to prevent miscommunication. Equipment flow emphasises machinery readiness, addressing delays caused by malfunctioning or unavailable tools. Materials flow focuses on efficient procurement and timely delivery, avoiding potential bottlenecks. People flow aligns workforce skills with project demands to minimise inefficiencies through effective planning. Beyond these technical flows, the framework incorporates more nuanced elements. Prior activity as a flow constraint emphasises task dependencies, ensuring readiness to avoid cascading delays (Ebbs and Pasquire, 2018). External conditions as a flow constraint account for uncontrollable factors like weather and regulations, promoting strategic anticipation to reduce their impact (Pasquire and Court, 2013). Safe space as a flow constraint addresses physical safety and psychological well-being, recognising that a safe environment fosters trust, motivation, and productivity (Ebbs et al., 2024). Among these flow constraints, shared understanding as a flow constraint bridges the technical and human dimensions by aligning project participants around common goals and constraints. Pasquire and Court (2013) argue that this flow is essential for collaboration and efficient decision-making, offering a paradigm shift in lean construction by prioritising relational dynamics. These advancements have reshaped lean construction thinking, with a greater acknowledgement of the critical interplay between technical processes and human relationships.

2.2 Flow Walk Activity and Make-Ready Planning

Pasquire and Ebbs, (2017) developed a process for project delivery more reliable using the eight-flow model. This evolved into a flow walk activity for engaging project stakeholders in early conversations to identify and remove constraints on scheduled tasks as part of make-ready planning (see Ebbs and Pasquire 2018). This flow walk activity has been tested with site supervisors and other site management staff involved in projects but not extensively with frontline site operatives. Ebbs *et al.* (2024) identify this exclusion as a critical gap because frontline operatives possess invaluable insights into on-the-ground constraints. Without their input, the breadth of constraint identification is limited, and opportunities for innovative, ground-level solutions can be missed. Rom and Green (2023) have advocated for the use of participatory approaches that emphasise worker-driven innovation and incorporate frontline insights to enhance planning, cohesion, and workplace development. The ability to successfully embed frontline site operatives into conversations about flow using the eight-flow model represents not just an operational improvement but will require a cultural shift, valuing their contributions as integral to the project's success. This shift, particularly in creating shared understanding, can lead to more accurate and timely constraint identification, stronger team cohesion, and greater productivity. Engaging frontline operatives in early conversations to resolve flow disruptions before their work commences challenges traditional construction hierarchies but could be transformative. However, questions remain on how to achieve this in practice. Therefore, the main question that this study seeks to address is how site operatives can be actively engaged in identifying and resolving constraints to site workflow through a structured collaborative practice using the eight-flow model.

3 Research Methodology

The study adopted an Ethnographic Action Research (EAR) methodology that comprised the three stages of inquiry, action, and reflection in multiple cycles across three cohorts comprising site operatives from drylining, mechanical and electrical and a specialist ceiling and interiors. This was part of a wider study on co-creating collaboration, innovation, and value through an innovation-driven approach to procurement that provides an enabling environment for site operatives to contribute towards productivity improvements. The EAR methodology was chosen because it offered the opportunity to engage directly with the frontline site operatives in their natural work environment on the construction site to jointly implement change whilst at the same time generating new knowledge.

The wider methodology, reported by Raiden and Manu (2024), consisted of four workshops delivered to three cohorts of site operatives (12 workshops in total). However, the focus of this present study is a detailed analysis of the outcome of the workshop on collaborative risk management using a flow activity with the site operatives. The main activity in this workshop drew on earlier work by Pasquire and Ebbs (2017) and Ebbs and Pasquire (2018) who developed the flow walk activity as a collaborative process to support the last planner system and help to make projects or tasks ready for site delivery. A prior flow mapping game was played to introduce the eight flows. The objectives of this workshop and the activities undertaken have been summarised in Table 1.

Table 1: Content of supply chain workshops with construction workers

Workshop	Objectives	Activities
Workshop on collaborative risk management using a flow activity	• how conversations about flow can improve production planning. • how to evaluate risks and constraints to site workflow • practice activity on flow that can help resolve common disruptions to site work.	• Case study activities on common site disruptions • Conversations and reliable promising • Basic rules for reliable promising • Flow mapping game activity and reflections • Flow walk activity on the wall. • Final reflections

Before the workshops, the supply chain (the main contractors and specialist trade contractor representatives) was provided an opportunity to input into the content and its relevance for improving productivity on site as shown from the co-design meetings in Table 2. The workshop on collaborative risk management using a flow activity was delivered in 3 rounds to 10 operatives in each round (30 participants in total). The participants had an average of 24.6 years of experience in their various trades.

Table 2: Ethnographic action research activities with the supply chain

Date	Co-design meetings with the main contractor	Co-design meetings with 3 specialist contractors	Workshop on collaborative risk management using a flow activity
17th Jun 2021		Co-design meeting 1	
14th Dec 2021	Co-design meeting 2		
15th Feb 2022			Round 1: Cohort 1 comprising drylining operatives and labourers
4th Apr. 2022		Co-design meeting 3	
12th Apr. 2022		Co-design meeting 4	
31st May 2022			Round 2: Cohort 2 comprising a mix of ceiling & interior fixers and mechanical and electrical operatives.
28th Jun 2022			Round 3: Cohort 3 comprising a mix of ceiling & interior fixers and mechanical and electrical operatives.

All three workshop rounds were held face-to-face in the site office during a live construction project site in the U.K, which had to be carefully managed. This access to a live site was possible due to the main contractor being an industry partner for the wider study. This project involved the construction of a £57m research facility to provide 12,790m2 of additional research exploitation capacity for the client organisation. The initial plan was to run each of the workshops for the three trades on the project separately i.e. the drylining trade, then the ceiling and interiors trade and lastly the mechanical and electrical fixing trade. However, after the first action cycle, feedback from the drylining trade on interfacing issues led to a mix of operatives for the 2 other rounds that followed, emphasising the link between observation, reflection and action in ethnographic action research (Raiden and Manu 2024). The methods of data collation adopted were the recording of observation notes during the workshops, the output of the flow activity undertaken and the post-observation feedback comments that participants were asked to provide. The data was analysed using a content analysis approach.

4 Findings and Discussion

The site operatives were initially not accustomed to voicing their views about issues that affected workflow and productivity on site. However, through the workshop intervention, they began to share insights on issues that affected them and provided suggestions on how these can be overcome to ensure smooth delivery (see Table 3). Participants also identified links between issues that were clustered under a given flow category (e.g., flow 1-information) and other flow categories (e.g., flow 8 – shared understanding).

Table 3: Output of flow activity with operatives during the three workshop rounds

Flow constraint	Issues	Interlinks to other flows
Flow 1: Information	Not told about delays; Incomplete or no information provided; Not having the right drawings on time; Where and what needs loading out; Whether wood was needed in bulkheads for support; Whether I have got heights, widths and all dimensions.	8,3,1
Flow 2: Equipment	Lack of trestles; Tools needed for Hilti pole for ceiling fixings, screws of all types, screw gun, snips, work tools; Lack of trolleys; MEWPS and scaffolding not available at the right time; Hoist taken down too early.	3,4,5,7
Flow 3: Materials	Missing materials; Lack of required metals: MFLA angles, top hat fixings, and moisture-resistant wall boards; Wrong deliveries; Unavailability of materials when needed; Logistics concerns.	1,4,7,8
Flow 4: People	Missing information from other managers; Other trades working in the same area Jobsworths; Other contractors obstructing work area; Other trades obstructing work area; Board lifter operated by 3 people.	5,7,8,1
Flow 5: Prior activity	Other trades not finished or cleared; Preload completed; Trestles for MEWP unavailable; Floor layers laying floors in hallways preventing access to rooms with materials; 12 rooms needed ready by week 1; 14 rooms needed ready by week 2	1,2,3
Flow 6: External condition	Water leaks that affect installed works leading to rework; Turnstiles, lift not working, Parking issues; Safe access on and off-site not provided (e.g. lighting); Roof leaking.	1,5
Flow 7: Safe space	Rooms occupied by other trades when needed. Rooms not tidy or clear for usage.	8,3,2
Flow 8: Shared understanding	What is needed and when; Materials obstructing work areas; Uncertainty over whether supervisors have instructed labourers to supply materials nearby and provided drawings with dimensions; Wrongly planned jobs such as wrong heights of services; Wrong designs and programmes; Agreed laydown areas; Having to double or triple handling of materials –boards.	1

The issues that manifested in Table 3 were mainly linked to a communication disconnect with the site operatives, unrealistic programming, material and logistics issues whilst the processes that integrate site operatives and collaborative processes that foster communication were critical for overcoming flow issues and improving productivity. These findings are discussed further.

4.1 Communication Disconnect

Participants consistently identified poor communication as a significant challenge, citing the overuse of email by managers and limited direct engagement. One participant noted, *"Too many emails—the art of conversation has been lost,"* while others mentioned, *"Managers haven't been told what's happening."* Experienced workers highlighted that lessons from past mistakes are often not learned due to communication breakdowns. The eight-flow model emphasises how poor communication disrupts workflows. Flow 1 (Information) emerged as a key constraint, with delays, missing dimensions, and incomplete drawings cascading into Flow 2 (Equipment) and Flow 3 (Materials), causing unavailable tools and incorrect deliveries. Coordination challenges in Flow 4 (People) and Flow 5 (Prior Activity) included obstructed spaces and conflicting schedules. External issues (Flow 6) like leaks and unsafe site access and cluttered work areas (Flow 7) further hindered productivity. Flow 8: Shared Understanding reflected broader inefficiencies caused by unclear instructions and poor planning, leading to rework and material handling delays. Participants valued collaboration, emphasising *“meeting other trades”* and *“talking more about upcoming works.”* They also appreciated identifying constraints, such as *“learning about plans that can’t be achieved,”* highlighting the importance of proactive communication to enhance workflows and efficiency. This aligns with Barros et al. (2022) and Gillespie et al. (2018), who highlight that effective communication strategies are critical for improving team motivation and resolving workflow inefficiencies, reinforcing this study's findings on the importance of direct engagement to enhance communication and collaboration.

4.2 Unrealistic Programming

Participants highlighted the disruptive impact of misaligned project timelines on workflow efficiency. Early starts without proper site readiness often forced teams to work under suboptimal conditions. One participant noted: *"We turn up early because the contract says so, even though there is no access."* Concurrent activities frequently caused inefficiencies and rework, such as ceilings being installed before prerequisite tasks were completed, as another participant observed: *"Ceilings go in even though we are not finished."* These challenges were compounded by recurring flow constraints in areas like information, materials, and equipment. Participants cited delays and incomplete details—such as missing drawing dimensions or material requirements—as major obstacles. One participant expressed frustration: *"We’re not told about delays or provided the right drawings on time, so we can’t plan properly."* Similarly, tools like MEWPs and scaffolding or materials like moisture-resistant wallboards were often unavailable or incorrectly delivered, creating cascading delays. As another participant recounted: *"We had to halt work because trestles and other tools needed for ceiling fixings weren’t on-site when required."* Conflicting activities among trades further obstructed workflows, with spaces frequently occupied or blocked. For example, floor layers completing hallways early hindered access to essential materials. A lack of shared understanding between teams and supervisors exacerbated the issue, leading to poorly planned activities, such as incorrect service heights or uncoordinated laydown areas, resulting in double or triple handling of materials. Rathnayake et al. (2023) support the need for addressing excess work-in-progress (WIP) time, variability, and workflow discontinuity to enhance construction productivity. Through the flow activity, the drylining team improved the initially planned work sequence and agreed on a coordinated approach with the electrical installers to avoid interfacing issues. This shows that engaging frontline operatives in flow conversations using the eight-flow model can address workflow discontinuity and improve productivity in practice. Additionally, their advocacy for location-based scheduling to resolve spatial conflicts and enhance coordination reinforces the importance of better sequencing and shared understanding to reduce delays and improve workflow efficiency.

4.3 Material and Logistics Issues

Inefficiencies in material handling and logistics were recurring issues, closely linked to other flow constraints, significantly impacting productivity. A critical challenge was the unavailability or incorrect delivery of materials, including moisture-resistant wallboards, MFLA angles, and top hat fixings. One participant noted, *“If plasterboards came on different pallets that we could move, we’d save so much time,”* highlighting inefficiencies caused by unsuitable packaging and handling. These issues were exacerbated by the absence of organised laydown areas and the need for multiple handling of materials. Poor planning often led to obstructed workspaces, forcing workers to relocate items - causing delays. Misaligned material delivery timings created storage challenges and contributed to rework. Additional complications arose from a lack of appropriate logistical equipment, such as trolleys and hoists, as noted in Flow 2 (Equipment), resulting in further delays. Interdependencies with other flows, particularly Flow 4 (People) and Flow 7 (Safe Space), were evident, as rooms occupied by other trades hindered material handling. Delayed or incomplete information about material requirements (Flow 1: Information) compounded these inefficiencies. Seppänen and Peltokorpi (2016) and Rajesh et al. (2020) highlight the detrimental effects of poor logistics on productivity. These studies advocate for centralised logistics centres, better delivery scheduling, and improved storage planning to enhance efficiency and productivity. This study provides evidence that the engagement of frontline operatives in early collaborative conversations on flow can also help to improve material and logistics planning for their work.

4.4 Integration of Site Operatives as Central to Success

Participants unanimously agreed that skilled and engaged site operatives were critical to project success. However, issues related to worker respect and involvement in the planning processes often demotivated teams. One participant stated, *"When you are heard, you feel valued,"* emphasising the need for a collaborative environment where workers feel respected, and their input is acknowledged. The "people flow" constraint revealed challenges, such as missing information from managers and conflicts with other trades occupying shared spaces, which hindered productivity and created frustration among workers. Poor coordination and space management, particularly noted in Flow 7 (Safe Space), often forced teams to work under suboptimal conditions, reducing efficiency. Workers also felt undervalued due to perceptions of being replaceable and the presence of "jobsworths," where rigid adherence to protocols stifled flexibility and collaboration. This lack of empowerment diminished motivation and engagement. These findings highlight the need to address worker-centric challenges through improved communication, involving the site teams in planning, and resolving conflicts between trades. Creating an environment where workers feel heard and valued can transform site dynamics, boosting morale and productivity. Mollo et al. (2020) underscore the role of respect for people in enhancing productivity and morale on construction sites, advocating for collaborative environments that address worker concerns. Ebbs and Pasquire (2018) have also advocated the use of flow walks to foster shared understanding and empower workers through involvement in planning and problem-solving – which this study has tested further with frontline site operatives.

4.5 Collaborative Tools that Foster Communication

The integration of collaborative tools and processes that foster communication offers the potential to address key constraints identified in the flow activity. Participants suggested the use of site-level flow task boards and WhatsApp group chats as effective tools for mitigating challenges related to information flow (Flow 1), equipment availability (Flow 2), and shared understanding (Flow 8). For instance, incomplete or delayed information about drawings and loading requirements under Flow 1 could be resolved through site-level flow task boards, which can provide daily updates and structured escalation. One participant noted, *"[flow boards] on site can keep communication lines open and allow us to escalate issues."* Similarly, WhatsApp's immediacy and flexibility could alleviate coordination issues under Flow 4 (People) and Flow 7 (Safe Space). Quick updates via WhatsApp as an informal platform help resolve flow issues over shared spaces, double handling of materials, or room readiness, ensuring smoother workflows. Ahmad Pozin et al. (2019) previously highlighted the use of WhatsApp in overcoming communication barriers because it enables real-time updates during construction projects. A participant remarked, *"WhatsApp saves time as feedback is real-time."* Tools like the site-level flow task boards could also address logistical concerns in Flow 3 (Materials) and Flow 2

(Equipment), enabling teams to identify and communicate missing or incorrect deliveries and unavailable equipment. These collaborative tools could help streamline communication and foster shared understanding (Flow 8), which Pasquire and Ebbs (2017) emphasise as essential to project systems.

5 Conclusions and Further Research

This study has contributed insight into how frontline construction site operatives can be embedded into collaborative flow conversations as part of make-ready planning using the eight-flow model as a structured framework. The findings have revealed the importance of direct engagement with frontline site operatives when seeking to identify and resolve workflow disruptions, which were primarily caused by poor communication, unrealistic work programming and inefficient material logistics. The flow activity applied in this study provided an opportunity for site operatives to engage in collaborative conversations that helped resolve workflow inefficiencies and improve productivity. This integration of frontline site operatives into flow conversations fostered collaboration and helped overcome traditional hierarchical barriers that prevented them from playing an active part in productivity improvement initiatives. The findings affirm the importance of promoting respect, inclusion, and collaboration when seeking to improve project outcomes at the level of site operatives. As a wider implication, these collaborative conversations on flow can be systematically integrated into pre-start meetings and daily toolbox talks, creating a continuous process of dialogue and improvement with frontline site operatives where they feel heard, and their input valued. Site operatives suggested using WhatsApp chat groups as an informal platform to share flow information. Institutionalising these practices as part of daily routines could drive proactive engagement and shared understanding, fostering productivity improvements through further research on these will be required.

A limitation of the EAR methodology adopted is that the findings are very context-specific and, hence cannot be generalised. Also, whilst aspects of the eight-flow model (e.g., materials, equipment) were intuitive for site operatives, others e.g., shared understanding, and external conditions required more explanation, which was aided by the flow mapping game. Future research can focus on replicating the study across diverse work trades, project types and organisational contexts, testing tools like site-level flow task boards to enhance operatives' engagement. Also, other models or frameworks on flow can be tested with frontline site operatives in addition to the eight-flow model to determine the most effective for stimulating flow conversations amongst this target group. Embedding discussions on flow constraints into existing site routines, such as toolbox talks, can broaden their focus beyond health and safety to include productivity and workflow issues, providing site operatives with opportunities to voice concerns, share insights, and collaborate on solutions. By integrating these discussions into standard practices, the construction industry can build a culture of collaboration and continuous improvement, empowering frontline site operatives to contribute to better project outcomes.

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