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SCHEDULING CONSTRAINTS AND HALAL INTEGRITY RISK IN SHARED FACILITY MANUFACTURING: A QUALITATIVE STUDY OF MALAYSIAN SMES

Irwan Ibrahim[1], Saiful Azmir Kasdi[2]*

[1]Department of Technology and Supply Chain Management Studies, Faculty of Business and Management, UiTM Puncak Alam, Selangor, Malaysia
irwan623@uitm.edu.my https://orcid.org/0000-0002-0887-2394

[21]Department of Technology and Supply Chain Management Studies, Faculty of Business and Management, UiTM Puncak Alam, Selangor, Malaysia
saifulazmir@uitm.edu.my https://orcid.org/0000-0001-5971-2721

*Corresponding Author

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Abstract:

Halal integrity is not a fixed attribute certified once and assumed to last, but a condition actively protected at every stage of production, including the moment a shared line switches between non halal and halal runs. While Malaysian halal research has examined certification, traceability, and logistics extensively, scheduling itself has received little direct attention despite being repeatedly flagged as a contamination risk. This phenomenological study explored how scheduling decisions shape halal integrity risk in Malaysian SMEs that share production equipment between halal and non halal goods. Fifteen semi-structured interviews were conducted with halal executives, production supervisors, and line operators across eight SMEs spanning food, nutraceuticals, and personal care. Findings revealed a consistent scheduling architecture built around protecting the changeover window, alongside two dominant risks, commercial pressure and inconsistent verifier availability, managed through a layered mix of formal procedures and informal coping strategies. The study extends existing conceptual scheduling literature with grounded, practitioner level evidence and offers practical guidance for SMEs and regulators alike.

Keyword:

Commercial Pressure, Halal Integrity, Halal Supply Chain, Production Scheduling, Shared Facility Manufacturing

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Introduction

Background of the Study

Malaysia has spent more than three decades building its reputation as the world's reference point for halal governance. Long before halal became a fashionable marketing term in Europe and North America, Malaysia had already established the Department of Islamic Development Malaysia (JAKIM) as the central certifying authority, developed the Malaysian Halal Management System, and positioned itself as the country other governments visit when they want to learn how halal assurance is supposed to work (Sarbani & Ibrahim, 2025; Kamali, 2013; Wan Yusoff, 2016). This reputation did not happen by accident. It was built on a very specific promise: that a product carrying the halal logo has remained halal at every single point of its journey, from the farm or factory to the consumer's plate (Ahmad & Ibrahim, 2025).

That promise is harder to keep than most people outside the industry realise. Halal integrity is not something that is achieved once during production and then locked in place. It has to survive storage, handling, transportation, and every changeover between one batch of goods and the next (Ali et al., 2017; Tieman et al., 2012). This is where scheduling quietly becomes one of the most consequential, and least discussed, variables in the entire halal supply chain. When a factory shares equipment between halal and non halal production runs, the order in which those runs are scheduled, the time allocated for cleaning between them, and the discipline with which that schedule is actually followed can decide whether the next batch is genuinely halal or only halal on paper.

In Malaysia, this issue is especially pressing among small and medium enterprises (SMEs), which make up the overwhelming majority of halal certified food and consumer goods manufacturers in the country (Ali & Suleiman, 2016; Muhamed et al., 2020). Unlike large multinational manufacturers that can afford dedicated halal only production lines, many Malaysian SMEs operate on shared facilities out of financial necessity. A single production line might run a non halal product in the morning and a halal certified product in the afternoon. Whether that switch is safe depends almost entirely on how well the changeover is scheduled, supervised, and verified, yet this operational reality receives remarkably little attention in the academic literature compared to topics such as certification procedures, traceability technology, and consumer perception.

Overview of the Halal Supply Chain in Malaysia

The halal industry has become one of Malaysia's most strategically important economic sectors. Industry reports indicate that Malaysia's halal related exports have climbed into the

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tens of billions of ringgit in recent years, with the government continuing to position the country as a gateway to the global halal market, which is itself projected to be worth trillions of US dollars by the end of the decade. To protect this position, JAKIM has continued tightening its requirements, and the National Halal Policy has placed growing emphasis on data governance, digital traceability, and end to end accountability across the supply chain rather than certification of the finished product alone.

Halal supply chain management, as conceptualised by Tieman (2007) and later expanded by Tieman et al. (2012), consists of interconnected activities including halal procurement, halal manufacturing, halal warehousing, halal distribution, and halal logistics. Each of these stages has its own body of research. Halal logistics and warehousing have been studied through the lens of segregation, dedicated assets, and contamination risk (Talib & Abdul Hamid, 2014; Rasi et al., 2017). Traceability has attracted considerable attention, particularly around RFID, blockchain, and Internet of Things applications that promise to verify a product's halal status at every stage of its movement (Nasir et al., 2011; Rejeb et al., 2021). Certification research has focused heavily on the bureaucratic burden faced by SMEs, the cost of compliance, and the training gap among auditors and factory personnel (Muhammad et al., 2020; Mohd Fauzi et al., 2020).

What is noticeably thinner is research that treats scheduling itself as an object of study. Kasdi et al. (2025) recently argued that scheduling deserves far more attention in halal supply chain research than it has received, noting that production timing, delivery windows, and sequencing decisions all carry direct implications for halal integrity. Their work, however, remained largely conceptual, mapping out approaches and opportunities rather than examining how scheduling actually unfolds inside real Malaysian factories. This study responds directly to that call by grounding the discussion in the lived experience of people who build, manage, and are affected by production schedules in shared halal facilities.

Problem Statement

Halal integrity is often discussed as though it were a fixed attribute, something a product either has or does not have. In practice, integrity is continuously produced and continuously at risk, and nowhere is that more visible than in facilities where halal and non halal production share the same physical space and equipment. When a shared line is scheduled poorly, several things can go wrong at once. Cleaning and changeover time can be compressed to meet delivery deadlines, increasing the chance of cross contamination between halal and non halal runs (Rahman et al., 2022). Supervisory staff who are trained to verify halal compliance may not be scheduled to be present during a critical changeover if shift planning does not account for their availability. Cold chain products face similar exposure when transport scheduling forces halal and non halal goods to share a delivery vehicle or a loading dock under time pressure (Rahim & Ibrahim, 2025).

These are not hypothetical risks. Fraud and unintentional cross contamination remain the most commonly cited threats to halal integrity according to JAKIM's own guidelines, and much of that threat originates not from deliberate wrongdoing but from operational pressure, tight margins, and scheduling decisions made without full awareness of their halal implications. Ambiguity in guidelines and weak coordination among the parties involved in day to day operations only compound the problem (Mohd Fauzi et al., 2022; Al-Shami & Abdullah, 2023). For SMEs operating on thin margins and limited staffing, the temptation to schedule for

efficiency first and halal compliance second is real, even when no one involved intends to compromise the product.

Despite how central scheduling is to this risk, the existing literature on Malaysian halal supply chains has approached the subject indirectly at best. Studies have documented the SWOT of halal logistics broadly (Talib & Abdul Hamid, 2014), the technological barriers to traceability (Tan et al., 2022, as cited in Shaharuddin et al., 2025), and the certification burden on SMEs (Muhamed et al., 2020), but very few have gone into the factory floor and asked operators, supervisors, and halal executives how scheduling decisions are actually made, negotiated, and sometimes compromised. This gap matters because scheduling is not a technical detail sitting quietly in the background. It is where policy meets practice, and where the promise of halal integrity is either honoured or quietly eroded.

Research Gap

Three specific gaps motivate this study. First, the halal supply chain literature in Malaysia has concentrated heavily on certification, traceability technology, and logistics infrastructure, while scheduling has been treated as a minor operational footnote rather than a distinct risk factor (Kasdi et al., 2025). Second, the studies that do touch on scheduling tend to be conceptual or quantitative, relying on models and frameworks rather than the accounts of the people who build and live inside real schedules on shared production lines. Third, almost all of the available scheduling related discussion has focused on cold chain logistics and transportation (Rahim & Ibrahim, 2025; Rahman et al., 2022), leaving manufacturing floor scheduling, particularly changeovers on shared halal and non halal lines, comparatively unexamined.

This study is designed to close that gap by asking, qualitatively and directly, how scheduling decisions are made inside Malaysian SME manufacturing facilities that share equipment between halal and non halal production, and what those decisions mean for halal integrity in practice.

Research Questions

This study is guided by the following questions.

1. How do Malaysian SME manufacturers schedule production runs on shared facilities used for both halal and non halal goods?
2. What scheduling related risks to halal integrity are identified by factory operators, supervisors, and halal compliance personnel?
3. What strategies, formal or informal, do these SMEs use to manage the tension between production efficiency and halal compliance when scheduling shared lines?

Research Objectives

Corresponding to the questions above, this study aims to:

1. Explore the scheduling practices used by Malaysian SME manufacturers operating shared halal and non halal production facilities.
2. Identify the specific scheduling related risks to halal integrity as perceived and experienced by those directly involved in production and compliance.
3. Examine the coping strategies and decision making processes SMEs use to balance operational efficiency against halal compliance obligations.

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Significance of the Study

For academia, this study extends the halal supply chain literature by treating scheduling as a legitimate and distinct area of inquiry rather than a subtopic of logistics or certification. It builds directly on the conceptual groundwork laid by Kasdi et al. (2025) and situates it within a qualitative, Malaysian SME specific context that has not yet been explored in depth.

For industry, the findings are expected to give SME owners, production planners, and halal executives a clearer picture of where scheduling decisions quietly introduce risk, along with practical insight drawn from the experiences of their peers rather than abstract compliance checklists.

For policy, the study offers JAKIM and related agencies grounded evidence of how scheduling functions as a compliance variable on the ground, which may usefully inform future guidelines, particularly as the National Halal Policy continues to push for tighter, more granular oversight of the entire supply chain rather than the finished product alone.

Scope and Limitations

This study focuses specifically on Malaysian SMEs in the food and consumer goods manufacturing sector that operate shared production facilities for halal and non halal goods. It does not extend to large multinational manufacturers with dedicated halal only lines, nor does it cover halal logistics providers, retailers, or the transportation segment of the supply chain in depth, although these areas are acknowledged as closely related and worthy of separate investigation. As a qualitative study, the findings are intended to provide rich, contextual understanding rather than statistically generalisable conclusions, and are drawn from the perspectives of a purposively selected group of participants within the Malaysian SME manufacturing context.

Literature Review

Halal Concept and Halal Integrity

The halal concept refers to what is lawful and permissible under Islamic principles, while haram refers to what is expressly prohibited. The distinction also requires Muslims to exercise caution when the status of a matter is uncertain. Al-Nuʿman ibn Bashir reported that the Prophet Muhammad stated that what is lawful is clear, what is unlawful is clear, and between them are doubtful matters that many people do not recognise. He further explained that a person who avoids doubtful matters protects both religion and honour (Sahih al-Bukhari, 2051). This hadith provides a clear ethical foundation for halal integrity because it requires organisations to avoid practices that may place a product's halal status in doubt, even when direct contamination has not yet been established.

Within manufacturing and supply chain operations, halal is therefore not limited to the absence of prohibited ingredients. It also concerns how materials are sourced, processed, handled, stored, transported, labelled, and presented to consumers. Halal integrity refers to the continuous preservation of a product's permissible status, authenticity, purity, and credibility throughout these activities. A product may originate from halal ingredients but lose its integrity through cross-contamination, mixing, substitution, inaccurate labelling, or improper handling.

Protecting halal integrity consequently requires consistent segregation, traceability, procedural control, and coordination among all parties involved in the supply chain (Ali et al., 2017; Tieman et al., 2012).

The Concept of Halal Supply Chain Management

Halal supply chain management did not emerge as a separate discipline overnight. It grew out of conventional supply chain management theory, borrowing its language of procurement, manufacturing, distribution, and logistics, and then layering onto it the requirements of Islamic law (Tieman, 2007). Tieman et al. (2012) offered one of the most widely cited definitions in the field, describing halal supply chain management as the management of a network of interdependent organisations that work together to control the flow of materials, products, and information in accordance with Shariah principles, with the ultimate goal of protecting halal integrity from source to consumer.

Halal integrity refers to the sustained assurance that a product remains permissible, uncontaminated, authentic, and compliant with Shariah requirements throughout its entire supply chain. It extends beyond the initial certification of ingredients or production facilities because halal status can be compromised through improper processing, cross-contamination, mixing, handling, storage, transportation, or inaccurate information. Halal integrity therefore depends on the consistent protection of raw materials, production processes, services, and product information from the point of origin to final consumption (Ali et al., 2017). From this perspective, halal integrity is not merely a certification outcome but an operational condition that must be continuously maintained through segregation, traceability, procedural control, and coordinated decision making across the supply chain (Tieman et al., 2012).

What distinguishes halal supply chains from conventional ones is not the structure of the chain itself but the additional layer of risk that must be actively managed at every node. Ali et al. (2017) proposed a supply chain integrity framework built around the idea that halal status is not a fixed property of a product but a condition that must be continuously safeguarded against contamination, mixing, and mishandling. This framing is important for the present study because it treats halal integrity as something produced through ongoing operational decisions rather than something certified once and then assumed to remain intact. Wan Yusoff (2016) reached a similar conclusion, arguing that Malaysia's halal industry, despite its regulatory sophistication, still struggles to achieve a genuinely integrated and streamlined supply chain because individual actors within the chain often optimise for their own efficiency rather than for the integrity of the system as a whole.

Halal Certification and the SME Experience in Malaysia

A substantial share of the Malaysian halal literature has focused on certification, and for good reason. JAKIM's Malaysian Halal Management System is often described as one of the most rigorous certification regimes in the world, built around a comprehensive set of compliance pillars that extend from raw material sourcing through to worker welfare and documentation. For large, well-resourced manufacturers, meeting these requirements is manageable. For SMEs, the picture looks quite different.

Muhammad et al. (2020) found that halal certification authorities themselves face manpower shortages and skill gaps among auditors, which slows down and complicates the certification process for applicants. On the applicant side, Muhamed et al. (2020) reported that SMEs frequently struggle with the bureaucratic burden and financial cost of certification, and that this burden shapes how these firms structure their operations more broadly. Mohd Fauzi et al. (2020) added that ambiguity in guidelines and weak coordination between the various government agencies involved in halal governance create additional friction for smaller firms that lack the compliance departments larger companies rely on. More recently, a review by Shaharuddin et al. (2025) reaffirmed that certification remains particularly difficult for SMEs navigating limited resources and complex bureaucratic procedures, even as the broader halal food industry in Malaysia continues to expand.

What is largely absent from this certification focused literature is an account of what happens after certification is granted. A certificate confirms that a facility met the required standards at the point of audit. It says very little about whether the day-to-day scheduling of production, particularly on shared lines, continues to protect that same standard month or years later. This is a gap the present study is positioned to address.

Halal Logistics, Traceability, and Technology Adoption

A second major strand of research concerns halal logistics and the technologies used to safeguard traceability. Talib and Abdul Hamid (2014) conducted an early SWOT analysis of halal logistics in Malaysia and identified fragmented infrastructure and inconsistent enforcement as persistent weaknesses, particularly outside major urban centres. Rasi et al. (2017) examined the practical implementation of halal logistics in Malaysian firms and similarly found that segregation of halal and non halal goods during transportation and warehousing remains inconsistently applied.

Technology has been proposed repeatedly as a solution to these gaps. Nasir et al. (2011) developed an early RFID based validation system intended to track halal status throughout the supply chain, and this line of work has since expanded considerably. Rejeb et al. (2021) reviewed how Internet of Things technologies can support traceability, supply chain efficiency, and authentication of halal status, while more recent studies have pointed to blockchain and manufacturing execution systems as promising tools for improving transparency (Tan et al., 2022, as cited in Shaharuddin et al., 2025; Rui & Kaliani Sundram, 2024). Even Malaysia's pharmaceutical sector has adopted similar traceability logic, with RFID and mobile applications used to track halal pharmaceutical products from raw material to finished good.
Despite this enthusiasm for technology, adoption remains uneven. Limited awareness, high implementation costs, and a shortage of skilled labour continue to restrict the uptake of these tools, particularly among SMEs (Shaharuddin et al., 2025). More importantly for the present study, traceability technology tracks and records what has already happened. It does not, on its own, determine how a shared production line is scheduled, who is present during a changeover, or how much time is allocated for cleaning between halal and non halal runs. Technology can verify a decision after the fact, but it cannot make the decision itself.

Scheduling in Supply Chain Management: General Perspectives

Scheduling has a long- and well-established history within general operations and supply chain management, quite separate from the halal context. Classical production scheduling theory is

concerned with sequencing jobs, allocating resources, and minimising costs or delays across a set of constraints (Vonderembse et al., 2006). Where multiple product types share the same production resources, sequencing decisions become particularly consequential, since the order in which jobs are run determines changeover time, resource utilisation, and the risk of errors during transition between one job and the next.

One useful lens for thinking about this is the Theory of Constraints, which holds that the overall performance of a system is limited by its most binding constraint, and that improvements elsewhere in the system will not meaningfully improve output unless that constraint is addressed. Applied to a shared halal and non halal production line, the constraint is rarely the machinery itself. It is far more often the changeover process, the cleaning protocol, and the availability of trained personnel to verify that the line has been properly reset before halal production resumes. Very little of the general scheduling literature engages with halal requirements directly, which leaves an opening for research that brings these two bodies of knowledge together.

Scheduling and Halal Integrity Risk: What We Know So Far

The clearest and most direct precedent for the present study comes from Kasdi et al. (2025), who argued that scheduling deserves recognition as a distinct area of concern within halal supply chain research. Their work outlined several approaches to scheduling in halal contexts and identified a range of challenges and opportunities, including the difficulty of balancing efficiency with compliance, the lack of standardised scheduling guidelines specific to halal operations, and the potential for digital tools to support better scheduling decisions in the future. Their contribution was largely conceptual, mapping the landscape rather than examining how scheduling actually plays out inside a working facility, and it did not draw on interviews or direct engagement with practitioners.

Closely related work has appeared in the context of cold chain logistics. Rahman et al. (2022) linked scheduling and handling practices in the halal cold chain to the risk of microbial contamination, providing empirical evidence that timing and handling decisions have measurable consequences for product safety and halal status. Rahim and Ibrahim (2025) extended this discussion by examining how climate related disruptions complicate agricultural supply chain scheduling in Malaysia, arguing that resilience planning must account for both environmental unpredictability and the need to protect halal integrity during rescheduled or delayed operations. A qualitative study of Terengganu's agro fisheries sector similarly found that inconsistent regulatory enforcement, infrastructure limitations, and fragmented supply chain integration outside urban centres compound the difficulty of scheduling reliable, halal compliant cold chain logistics, echoing earlier observations by Ab Talib and Chin (2018) about the uneven reach of halal logistics enforcement across the country.

Taken together, this body of work confirms that scheduling matters to halal integrity, but it remains concentrated on transportation, cold storage, and conceptual mapping. Manufacturing floor scheduling, and specifically the changeover between halal and non halal production on shared equipment, has not received the same attention, despite being flagged repeatedly, if briefly, as a contamination risk in the certification literature discussed earlier in this chapter.

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Shared Facility Manufacturing and Contamination Risk

Shared facility manufacturing sits at an uncomfortable intersection of economic necessity and compliance risk. For many Malaysian SMEs, investing in a dedicated halal only production line is simply not financially realistic, particularly for firms producing lower volume or specialised products (Ali & Suleiman, 2016). Sharing equipment between halal and non halal runs is therefore a common and, in many cases, unavoidable operational reality rather than a sign of poor management.

The contamination risk this creates has been acknowledged in principle throughout the literature. JAKIM's own guidance identifies the mixing of halal and non halal materials at any stage of production as one of the most serious threats to halal integrity, and researchers have echoed this concern in the context of cold storage and transportation (Rahman et al., 2022). What is missing is a grounded account of how the people responsible for these facilities actually manage that risk day to day. Do they build in dedicated cleaning windows between halal and non halal runs, and are those windows consistently respected under production pressure. Who is scheduled to verify a changeover, and what happens when that person is unavailable. These are precisely the kinds of questions a qualitative, interview-based approach is well suited to answer, and precisely the kind of detail that conceptual or quantitative studies are not designed to capture.

Theoretical and Conceptual Framework

This study draws on two complementary theoretical lenses. The first is the Theory of Constraints, used here not in its original manufacturing optimisation sense but as a way of framing scheduling, and specifically the changeover process, as the binding constraint through which halal integrity risk is most likely to enter a shared production system. The second is institutional theory, which has previously been applied to halal logistics research to explain how firms respond to regulatory pressure, industry norms, and the expectations of certifying bodies. Institutional theory helps explain why SMEs might adopt formal scheduling protocols to satisfy JAKIM's expectations on paper, while day to day practice on the factory floor may look quite different once production pressure sets in.

Together, these two lenses direct attention to the same central idea from two different angles. The Theory of Constraints points to scheduling as the operational bottleneck where risk concentrates. Institutional theory points to the gap that can open up between formal compliance and informal practice under pressure. This study sits deliberately in that gap, using qualitative inquiry to explore what is actually happening between the two.

Research Gap

This study addresses that gap by asking Malaysian SME manufacturers, supervisors, and halal compliance personnel to describe, in their own words, how scheduling decisions are made on shared halal and non halal production lines, and what those decisions mean for the integrity of the products that eventually reach the market. The following chapter sets out the qualitative methodology used to pursue this inquiry.

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Methodology

Research Paradigm

This study is grounded in an interpretivist paradigm, which holds that reality, particularly social and organisational reality, is constructed through the meanings people attach to their experiences rather than existing as a single fixed truth waiting to be measured (Creswell & Poth, 2018). Scheduling decisions on a shared halal and non halal production line are not simply technical facts that can be read off a production calendar. They are lived through by supervisors who negotiate deadlines, by halal executives who must decide whether to sign off on a rushed changeover, and by line operators who feel the pressure of both compliance and productivity at the same time. An interpretivist stance allows this study to take those lived meanings seriously rather than reducing them to numbers on a schedule.

Research Design: Phenomenology

A phenomenological design was chosen for this study. Phenomenology is concerned with understanding the essence of a lived experience shared by a group of individuals, and with describing what that experience is like from the inside rather than explaining it from an outside, theoretical vantage point (Moustakas, 1994; Van Manen, 1990). This fits the aim of the present study closely. The research questions are not asking whether scheduling causes contamination in some measurable statistical sense. They are asking what it is actually like to be responsible for, or affected by, scheduling decisions on a shared halal production line, and what meaning participants themselves attach to the risks and trade offs involved.

Phenomenology traces its philosophical roots to Husserl, who argued that researchers should set aside their own preconceptions, a process often referred to as bracketing or epoche, in order to see a phenomenon as it presents itself to the people experiencing it (Husserl, 1970, as discussed in Moustakas, 1994). This study adopts that same discipline. Rather than approaching interviews with a fixed assumption about how scheduling ought to work, the researcher aims to bracket prior expectations drawn from the literature reviewed in Chapter 2 and to let participants describe, in their own words, how scheduling decisions actually unfold in their facilities.

Given that the study seeks the shared essence of this experience across a reasonably large and varied group of participants rather than an in depth account of one or two specific sites, phenomenology was judged more suitable than a case study design, and given that the intention is to describe a lived experience rather than to build new theory from the ground up, phenomenology was also judged more appropriate than grounded theory for the purposes of this research.

Population and Sampling

The population for this study consists of individuals working within Malaysian SMEs that operate shared production facilities for halal and non halal goods, specifically those who are directly involved in, or directly affected by, scheduling decisions on those shared lines. This includes production supervisors and planners who build and adjust the production schedule, halal executives and compliance officers who are responsible for verifying that changeovers

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meet halal requirements, and line operators who carry out the physical work of switching a shared line from one production run to another.

Purposive sampling was used to select participants, a strategy well suited to qualitative research where the goal is to identify individuals who can speak knowledgeably and directly to the phenomenon under investigation rather than to achieve statistical representativeness (Patton, 2015). To be included, participants needed to meet three criteria. First, they needed to be currently employed, or have been employed within the past two years, at a Malaysian SME manufacturing facility that shares production equipment between halal and non halal goods. Second, they needed to hold a role with direct involvement in scheduling, changeover supervision, or halal compliance verification. Third, they needed to be willing to speak candidly about their experiences, since the value of a phenomenological interview depends heavily on the depth and honesty of what participants are willing to share.

Sample Size and Data Saturation

This study plans to recruit more than ten participants drawn from a range of different SME facilities across relevant manufacturing sub sectors, rather than concentrating recruitment within a single company. Drawing participants from multiple SMEs, instead of one or two, was a deliberate choice consistent with the phenomenological aim of identifying an essence of experience that holds across different organisational contexts rather than one that is peculiar to a single workplace culture.

The precise final number of participants will be guided by the principle of data saturation, the point at which additional interviews stop producing meaningfully new information or themes (Saunders et al., 2018). Phenomenological studies commonly work with sample sizes in a similar range, and Creswell and Poth (2018) note that phenomenological research typically draws on a relatively small but information rich group of participants who have all lived through the phenomenon being studied. Recruitment beyond ten participants will continue if new interviews continue to surface fresh insights and will be brought to a close once the researcher observes clear repetition across accounts.

Data Collection Method

Data will be collected exclusively through semi-structured, one on one interviews. This method was chosen because it offers a balance that suits phenomenological inquiry particularly well. A fully structured interview would risk closing down the very lived detail this study is trying to capture, while a completely unstructured conversation would make it difficult to ensure the interviews stay focused on scheduling and halal integrity across a wide participant group. A semi-structured format allows a consistent set of guiding questions while leaving enough room for participants to follow their own train of thought, describe specific incidents, and raise concerns the researcher may not have anticipated (Patton, 2015).

Each interview will begin with a few general questions about the participant's role and their day-to-day involvement with production scheduling, before moving into more focused questions about how halal and non halal runs are sequenced, how changeovers are planned and supervised, what happens when schedules come under pressure, and how participants personally experience the tension between production efficiency and halal compliance. Interviews are expected to last between forty-five minutes and one hour and will be conducted

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in either Bahasa Malaysia or English depending on the participant's preference, in order to allow participants to express themselves as naturally and fully as possible.

With participant consent, interviews will be audio recorded and later transcribed verbatim. Where a participant prefers not to be recorded, detailed field notes will be taken instead, though every effort will be made to encourage recording given how much richer verbatim transcripts tend to be for phenomenological analysis.

Data Analysis

Data will be analysed using a phenomenological approach adapted from Moustakas (1994) and Colaizzi (1978), both of which offer a structured way of moving from raw transcripts to a description of the shared essence of an experience. The process will follow several stages. Transcripts will first be read multiple times in full to gain a sense of the whole before any coding begins. Significant statements directly relevant to scheduling and halal integrity will then be extracted from each transcript. These statements will be organised into clusters of meaning, which will in turn be grouped into broader themes shared across participants. Finally, these themes will be woven into a composite description that attempts to capture the essential structure of what it is like to manage, supervise, or work under scheduling decisions on a shared halal production line.

Throughout this process, the researcher will continue to practise the bracketing, deliberately setting aside assumptions drawn from the literature review in order to let themes emerge from participants' own accounts rather than being imposed from the outside. Where useful, thematic analysis principles as described by Braun and Clarke (2006) will support the coding process, particularly in the early stages of organising significant statements into coherent clusters.

Trustworthiness and Rigour

Qualitative research is judged by different criteria than quantitative research, and this study follows the framework proposed by Lincoln and Guba (1985), which centres on credibility, transferability, dependability, and confirmability rather than the validity and reliability standards used in quantitative work.

Credibility will be supported through prolonged engagement with each participant during the interview itself, careful verbatim transcription, and member checking, where participants will be given the opportunity to review a summary of their interview to confirm it accurately reflects what they intended to convey. Transferability will be supported by providing thick, detailed description of the participants, their organisational context, and the conditions under which data was collected, allowing readers to judge for themselves how far the findings might apply to other similar settings. Dependability will be addressed by maintaining a clear audit trail of how themes were developed from raw data, and confirmability will be supported by the bracketing process described earlier, along with reflexive notes the researcher will keep throughout data collection and analysis to track and disclose any personal assumptions that might otherwise shape the findings.

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Ethical Considerations

This study involves human participants discussing sensitive operational and compliance matters, some of which may touch on practices that do not fully align with formal halal guidelines. Several ethical safeguards will therefore be put in place. Informed consent will be obtained from every participant before the interview begins, with a clear explanation of the study's purpose, the voluntary nature of participation, and the participant's right to withdraw at any point without consequence. All participants and their employing organisations will be assigned pseudonyms in the final report, and any details that could identify a specific individual or company will be removed or generalised. Recordings and transcripts will be stored securely and accessible only to the researcher and will be retained only for as long as required by the relevant institutional research ethics guidelines. Given the sensitivity of some of the material participants may share, particular care will be taken to ensure no participant faces professional risk as a result of their honesty, and the researcher will remind participants that they are free to decline to answer, or to speak in general terms, on any question that feels too sensitive to answer directly.

Findings

Introduction

This chapter presents the findings of the fifteen interviews conducted with halal executives, production supervisors, and line operators working across eight Malaysian SMEs that share production equipment between halal and non halal goods. In keeping with the phenomenological design, the aim here is not to test a hypothesis but to describe, as faithfully as possible, what it is actually like to make, live under, and be held accountable for scheduling decisions on a shared halal production line. The chapter begins with a short overview of the participants and the saturation process, moves through eight themes that emerged from the data, and closes with a composite description that draws these themes together into a single account of the shared experience.

Quotations from participants are used throughout to let their own words carry the weight of the findings, since this is, at its core, what phenomenological reporting is meant to do (Moustakas, 1994). Each quotation is labelled with the participant code, role, and company pseudonym.

Overview of Participants and Interview Process

Fifteen participants took part in the study, drawn from eight Malaysian SMEs spanning food manufacturing, nutraceuticals, cosmetics and personal care, frozen food, bakery and confectionery, sauces and condiments, and consumer goods. Five participants were halal executives or compliance officers, five were production supervisors or planners, and five were line operators or technicians, a spread that was deliberately maintained so that the compliance, planning, and hands on perspectives on scheduling would each be represented in roughly equal depth. Interviews ranged from forty five to sixty one minutes and were all audio recorded with consent, consistent with the protocol.

What became clear almost immediately is that although the fifteen participants worked in quite different sub sectors, from bakery ovens to nutraceutical granulators, the underlying structure of their scheduling experience was remarkably consistent. Whether the shared equipment was

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a filling line, a mixer, or a freezer tunnel, the same basic tension kept surfacing, protecting the time and attention a changeover needs against the pressure to keep the line moving.

Data Saturation

Saturation tracking during the interview process, summarised in the accompanying tracking table, showed that the core scheduling pressures identified by participants, customer deadlines, cleaning time constraints, and the need for a trained verifier, began repeating consistently from around the seventh interview onward. By the final block of interviews (P13 to P15), new material was increasingly specific to a particular incident rather than conceptually distinct from what earlier participants had already described. This pattern is consistent with methodological guidance suggesting that saturation in a reasonably homogeneous, purposively sampled group can often be reached within twelve to fifteen interviews (Saunders et al., 2018). On this basis, fifteen interviews were judged sufficient to support the thematic analysis presented below, while acknowledging that a genuinely new sub sector or an unusually different organisational context could still surface fresh insight.

Thematic Findings

Eight themes emerged from the analysis. They are presented below roughly in the order they map onto the study's three research questions, beginning with how scheduling is structured, moving through the risks and pressures participants described, and ending with how they respond to and would improve the system.

Scheduling Architecture for Shared Lines

Almost every participant described some version of the same underlying logic for managing a shared line, sequencing production so that halal runs are grouped together and placed before non halal runs, or separating non halal production into a clearly bounded block followed by a full cleaning cycle. P02 described this directly, explaining that the company uses campaign production, usually several halal batches together before changing to non halal products. P09 described an even more conservative version of the same principle, noting that non halal runs are rare and placed at the end of the week, followed by a full sanitation cycle.

This finding echoes what Talib and Abdul Hamid (2014) identified as a core weakness and strength of Malaysian halal logistics, segregation practices that work well when consistently applied but depend heavily on discipline rather than physical separation. What the interviews add to this picture is the specific mechanism SMEs use to manage that discipline without dedicated infrastructure, grouping by product family, colour, fragrance, or viscosity, a practice several participants across very different sub sectors converged on independently.

Changeover as the Operational Constraint

If one idea united all fifteen interviews, it was that the changeover itself, not the production run before or after it, is where risk actually concentrates. Participants described changeover durations ranging from ninety minutes to a full eight-hour shift depending on the product and equipment involved, but the details mattered less than the consistent message that this window is treated, at least formally, as non-negotiable. P04 stated it plainly, describing an eight-hour changeover for frozen equipment and adding that it is not supposed to be shortened.

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This finding lends direct empirical weight to the largely conceptual argument made by Kasdi et al. (2025), that scheduling deserves treatment as a distinct halal integrity risk factor rather than a background operational detail. It also resonates with Rahman et al. (2022), whose research linked handling and timing decisions in the halal cold chain to measurable contamination risk. What emerges clearly here is that shop floor participants, across roles, already intuitively understand the changeover as what Theory of Constraints literature would call the binding constraint of the system, even if they never use that language themselves.

Commercial and Operational Pressure

Every single participant, without exception, could recall a specific incident where commercial or operational pressure threatened to compress the changeover window. The sources of that pressure varied by sub sector. Export cut off dates and container bookings created pressure for P10 at a sauce manufacturer, while festive demand and cold room congestion created pressure for P04 at a frozen food producer, and a social media driven order surge created pressure for P08 at a cosmetics SME. P01 summarised the seasonal pattern that many participants echoed, noting that pressure is highest near festive seasons when the order volume increases sharply.
What stood out was how often this pressure originated upstream of the factory floor entirely. P05, a bakery halal executive, made this connection explicit, observing that small firms often create their own scheduling pressure through informal customer promises. This finding extends the certification and SME literature discussed in Chapter 2 (Muhamed et al., 2020; Mohd Fauzi et al., 2020) by showing that the burden SMEs face is not only the cost and bureaucracy of certification itself, but the everyday commercial decisions, made by sales staff who may never set foot on the production floor, that quietly reshape the risk profile of the schedule those compliance systems are meant to protect.

Human Availability and Competence

A theme that cut across roles but was most sharply felt by halal executives and line operators, was the risk created when a trained verifier or competent worker is simply not present when needed. P03 raised this in the context of night shifts, explaining that a batch was rescheduled to the morning rather than run with weak supervision because the night team had less halal trained staff. P08 described almost the identical situation in a cosmetics SME, limiting an order surge because the required verifier was not available at night.

This theme was not confined to compliance staff. P11, a line operator, wanted one more trained operator during major changeovers because fatigue increases when the same small team works overtime, and P14 raised concern when temporary workers were assigned without halal training. This finding gives concrete, human texture to what the certification literature has so far only gestured toward in the abstract, that manpower shortages and skill gaps are not just a problem for JAKIM's auditors (Muhammad et al., 2020) but a lived, recurring anxiety for the people who staff production lines night after night.

Formal Compliance Versus Practical Execution

Participants consistently described two layers operating side by side, a formal system of SOPs, written approvals, and sign off requirements, and a practical, floor level negotiation of what that system actually allows under pressure. Most participants were quick to insist that the formal system generally held. P09 explained that no cleaning stage is omitted even under

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dispatch pressure, and P14 noted that management did not shorten the changeover during a supply delay, choosing overtime instead.

At the same time, several accounts revealed how close that formal system can come to bending. P13 offered one of the more candid observations in the entire dataset, noting that the standard time sometimes shows two hours even when operators know four hours are needed, a quiet mismatch between the schedule on paper and the reality on the floor that only surfaced when quality later rejected the line. This finding gives empirical grounding to the institutional theory perspective introduced in Chapter 2, illustrating exactly the kind of gap between symbolic, paper level compliance and substantive, everyday practice that institutional theorists describe, and it suggests that formal SOPs alone, however rigorous, are only as reliable as the realism of the standard times built into them.

Protective Coping Strategies

Participants were not passive in the face of these pressures. Across all fifteen interviews, a consistent set of informal, protective strategies emerged, strategies that reduced time pressure without cutting corners on verification itself. P01 described grouping products with similar ingredients to reduce cleaning complexity, a strategy echoed almost word for word by P05 at the bakery and P10 at the sauce manufacturer. P12 described photographing dismantled equipment to speed accurate reassembly, and P15 described keeping a prepared trolley of approved tools, covers, and tags specifically to prevent unapproved tools from entering a cleaned area.

What distinguishes these strategies from the compliance shortcuts that JAKIM's guidelines warn against is precisely that they target time waste, searching, coordination delay, uncertainty, rather than the verification steps themselves. Several participants were careful to draw this distinction unprompted. P02 stated that pre labelling and staging materials save time without skipping cleaning steps, and P04 was emphatic that the company does not accept shortcuts involving reduced washing or skipped inspection. This theme suggests that experienced shop floor staff have developed a fairly sophisticated, informal risk logic of their own, one that current literature, focused heavily on formal SOPs and digital traceability tools, has not yet captured in much detail.

Cross Functional Coordination

A recurring source of both risk and resolution in the data was the quality of coordination between departments that do not always share the same priorities, sales, planning, maintenance, quality, and halal compliance. When this coordination broke down, the consequences were immediate. P15 described a maintenance team working after cleaning had already been completed, creating a genuine recontamination risk that was only caught because someone flagged it. When coordination improved, so did outcomes. P07 described how requesting preventive maintenance ahead of a major campaign reduced unexpected stoppages the following month, and P08 described how a forty-eight-hour schedule freeze, introduced after repeated late sales driven changes, reduced overtime and cleaning chemical use at the same time.

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This theme reinforces a point made only briefly in the certification literature (Mohd Fauzi et al., 2020), that weak coordination among the parties involved in halal governance is a genuine operational vulnerability, but it extends that point by showing precisely which internal boundaries, sales and production, maintenance and sanitation, tend to be where coordination most often fails.

Desired System Improvements

When asked what single change they would make, participants converged on a small number of closely related ideas. Several, including P01 and P08, wanted halal status and compliance sign off built directly into a digital scheduling system, so that a risky sequence could not be released without review. P06 and P13 both wanted better, more realistic data on actual cleaning times by product pair, arguing that current standard times are too broad and either waste capacity or create pressure depending on which way they are wrong. P03 and P15 both wanted staffing and maintenance readiness treated as part of the schedule itself, not managed separately from it.

Taken together, these suggestions describe a fairly coherent, shared vision, one in which scheduling stops being treated purely as a production planning exercise and starts being treated, in P01's own words, as a halal control point, not merely a production matter.

A Composite Description of the Lived Experience

Drawing these eight themes together, a single composite picture emerges of what it feels like to work inside a Malaysian SME that shares production equipment between halal and non halal goods. It is an experience built around one recurring, almost universal tension, the felt need to protect a changeover window that everyone agrees is essential, against a stream of commercial and operational pressures that rarely originate from bad intentions but that nonetheless press against that window from every direction, urgent customer orders, machine breakdowns, absenteeism, and a night shift with too few trained staff.

Participants across all three roles described this tension not as a crisis but as a routine, almost daily negotiation, one they had each developed their own quiet strategies to manage, grouping products, staging tools, pairing new workers with experienced ones, and escalating concerns when informal strategies were not enough. What holds this system together, more than any single written procedure, appears to be a shared, deeply internalised belief among participants, expressed in different words by a halal executive, a supervisor, and a line operator alike, that halal integrity is worth protecting even when it costs output. Whether that belief continues to hold under increasing commercial pressure, and what would help it hold more reliably, are questions this study now turns to in the discussion.

Summary of Findings by Research Question

In relation to the first research question, how Malaysian SME manufacturers schedule production on shared halal and non halal lines, the findings show a broadly consistent architecture built around grouping, sequencing, and a protected changeover window, adapted informally to each sub sector's specific cleaning challenges.

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In relation to the second research question, the scheduling related risks to halal integrity identified by participants, the findings point most strongly to commercial pressure compressing changeover time, and to the unpredictable availability of trained halal verifiers, particularly on night shifts and during peak seasons.

In relation to the third research question, the strategies SMEs use to balance efficiency and compliance, the findings show a combination of formal mechanisms, written SOPs, sign off requirements, escalation to management, and a rich layer of informal, protective floor level practices that participants were careful to distinguish from actual compliance shortcuts.

Discussion

Revisiting the Research Gap

Literature reviews closed by identifying three gaps in the existing literature. Scheduling was acknowledged across multiple strands of halal supply chain research as consequential, yet rarely treated as a central object of study. The studies that came closest, notably Kasdi et al. (2025), remained conceptual rather than grounded in fieldwork. And almost none of the available literature drew on the direct accounts of the people who build and live inside these schedules.

The findings speak to all three gaps at once. Every one of the fifteen participants, regardless of role or sub sector, treated scheduling, and specifically the changeover window, as the point where halal integrity is either protected or put at risk. This was not a peripheral concern participants mentioned in passing. It was, in a very real sense, the thing they most wanted to talk about once the conversation opened up. That alone supports the central argument of this study, that scheduling deserves recognition as a distinct halal integrity risk factor rather than a footnote to certification or logistics.

Discussion by Research Question

How Scheduling Decisions Are Made on Shared Lines

The first research question asked how Malaysian SME manufacturers actually schedule production on lines shared between halal and non halal goods. The findings show a fairly consistent architecture across very different sub sectors, campaign style grouping of halal runs, sequencing from halal to non halal rather than alternating between the two, and a changeover window that is formally protected even when informally negotiated.

This finding both confirms and extends earlier work. Talib and Abdul Hamid (2014) identified segregation as a persistent weakness in Malaysian halal logistics, largely because so few SMEs can afford dedicated infrastructure. What this study adds is that segregation, where it succeeds, is being achieved through scheduling discipline rather than physical separation. Grouping products by cleaning difficulty, colour, or fragrance, as described by participants like P08 and P10, functions as a kind of low-cost substitute for the dedicated lines that larger, better resourced manufacturers can afford. This is a genuinely useful finding for an industry where most players are SMEs (Ali & Suleiman, 2016), because it suggests that meaningful halal risk

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reduction does not always require capital investment. Sometimes it requires better sequencing logic and the discipline to stick to it.

Scheduling Related Risks to Halal Integrity

The second research question asked what risks participants themselves identified. Two risks dominated the data, commercial pressure compressing the changeover window, and the unpredictable presence of a trained halal verifier, particularly during night shifts and peak seasons.

The commercial pressure finding aligns closely with Rahman et al. (2022), whose Malaysian cold chain research linked timing and handling decisions directly to microbial contamination risk, and with Rahim and Ibrahim (2025), who argued that disruption, whether from climate events or, in this study's case, sudden demand spikes, forces difficult rescheduling decisions that can compromise halal safeguards if not carefully managed. What this study contributes beyond that prior work is a clearer picture of where that pressure actually originates. It was striking how often participants, particularly halal executives like P01 and P05, traced pressure back to decisions made far upstream of the factory floor, a sales team promising a delivery date without checking changeover requirements, or a marketing campaign generating an order surge nobody in production anticipated. This suggests that halal integrity risk in SMEs is not purely a production floor problem. It is, at least in part, a cross departmental communication problem that begins in sales and marketing long before it reaches a mixer or a filling line.

The human availability finding is, in some ways, the most novel contribution of this study relative to the existing literature. Muhammad et al. (2020) documented manpower shortages and skill gaps among JAKIM's own certification auditors, but the interviews in this study reveal a parallel, largely undocumented shortage inside the SMEs themselves, a shortage of trained verifiers available at the exact moment a changeover needs to happen. P03's account of rescheduling a batch to the morning because the night team lacked halal trained staff, and P08's account of limiting an order surge for the same reason, point to a specific, actionable vulnerability that has not been clearly named in prior Malaysian halal research. Certification confirms that a facility has enough trained personnel in principle. It does not guarantee that person is on shift at two in the morning when a changeover suddenly needs to happen.

Balancing Efficiency and Compliance

The third research question asked how SMEs manage the tension between production efficiency and halal compliance. The findings show a layered response, formal mechanisms such as SOPs and sign off requirements sitting alongside an informal, and genuinely inventive, layer of protective practices, grouping, prestaging, photographing dismantled equipment, and pairing new workers with experienced ones.

This finding pushes back gently against a certain assumption running through parts of the technology focused literature (Rejeb et al., 2021; Nasir et al., 2011), which tends to frame halal risk management primarily as a technology adoption problem, more RFID, more blockchain, more digital traceability. The participants in this study were, almost without exception, managing risk successfully through low cost, human centred coordination strategies long before any digital system entered the conversation. This does not mean technology has no role to play. Several participants, including P01 and P08, explicitly wanted digital scheduling

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systems that would refuse to release a risky sequence without compliance sign off. But it does suggest that technology's most useful role in this context may be formalising and enforcing practices that experienced staff have already worked out informally, rather than replacing human judgement altogether.

Theoretical Implications

The conceptual framework combined the Theory of Constraints with institutional theory, and the findings give reasonably strong support to both lenses.

The Theory of Constraints framing, treating the changeover as the system's binding constraint, was echoed almost exactly in participants' own language, even though none of them had likely encountered the theory formally. P04's insistence that the changeover window is not supposed to be shortened, and the consistent, almost ritualistic protection of that window across every participant regardless of sub sector, suggests that shop floor practitioners have arrived, through hard won experience, at the same conclusion operations researchers arrive at through formal modelling, that the constraint deserves protection even when everything around it is under pressure.

Institutional theory helps explain the gap this study also uncovered, most visibly in P13's account of standard times that did not match what operators knew from experience to be true. This is a textbook example of what institutional theorists describe as decoupling, where formal procedures exist to satisfy external expectations, in this case JAKIM and internal quality systems, while day to day practice adapts around them in ways the formal system does not fully capture. What this study adds to that theoretical picture is a sense of where decoupling is most likely to occur, not at the level of whether cleaning happens at all, participants were consistent that it always does, but at the level of how much time the formal schedule allocates for it to happen properly.

Practical Implications for Malaysian SME Manufacturers

Several practical implications follow directly from the findings. SME owners and production planners might consider building cleaning and changeover duration into capacity planning using actual historical data rather than fixed, standardised times, an approach several participants, including P06, had already begun adopting informally after being burned by unrealistic standards. Firms might also benefit from formally involving halal compliance staff earlier in the scheduling process, ideally at the point where sales teams are negotiating delivery dates, rather than only at the point of changeover sign off, since so much of the pressure participants described originated from commitments made before production was ever consulted.

The staffing gap also points toward a fairly specific, low cost intervention, ensuring every shift, including night shifts, has at least one trained verifier or a clearly designated deputy, rather than treating halal compliance coverage as a daytime function. Several participants had already pushed their own organisations toward exactly this kind of change after a near miss, suggesting it is both feasible and, once implemented, well supported by staff.

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Implications for Policy

For JAKIM and related agencies, these findings suggest that scheduling could usefully be incorporated more explicitly into audit criteria and guidance documents, moving beyond a general expectation of segregation toward more specific attention to changeover duration standards, verifier availability across all shifts, and the upstream commercial decisions that shape production pressure. The National Halal Policy's continuing emphasis on tighter, more granular oversight across the supply chain provides a natural opening for this kind of guidance, and the findings of this study suggest that Malaysian SME practitioners themselves are already thinking in these terms and would likely welcome clearer standards rather than experience them as an additional burden.

Limitations of the Study

Several limitations deserve honest acknowledgement. The study drew on fifteen participants across eight SMEs, which is appropriate for a phenomenological design aimed at describing a shared lived experience, but it does not support claims about how common or representative these experiences are across Malaysia's much larger population of halal certified SMEs. The findings rely entirely on participants' self-reported accounts of their own and their organisation's practices, which were not independently verified against production records or direct observation, and it is possible that participants presented their organisations, and themselves, somewhat more favourably than day to day reality would fully support. The study also captured a single interview per participant at one point in time, meaning it cannot speak to how scheduling practices or pressures shift across a full seasonal cycle, something several participants suggested varies considerably between ordinary periods and festive peaks. Finally, all participants were drawn from Peninsular Malaysian SMEs operating in a specific set of sub sectors, and the findings may not transfer cleanly to East Malaysia, to much larger manufacturers, or to industries such as halal logistics and transportation that fell outside this study's scope.

Conclusion And Recommendations

Summary of the Study

This study began from a fairly simple observation, that halal integrity is not a fixed property stamped onto a product once and left alone, but something that has to be actively protected at every stage of a product's journey, including the moments when a shared production line switches from a non halal run to a halal one. While the Malaysian halal literature has produced a rich body of work on certification, traceability technology, and logistics, scheduling itself, and particularly the changeover process on shared facilities, had received comparatively little direct attention, despite being repeatedly flagged, almost in passing, as a contamination risk.
To address that gap, this study set out to explore how Malaysian SME manufacturers schedule production on shared halal and non halal lines, what scheduling related risks to halal integrity are identified by the people directly involved, and what strategies these SMEs use to balance production efficiency against halal compliance. Using a phenomenological design, fifteen semi-structured interviews were conducted with halal executives, production supervisors, and line operators across eight Malaysian SMEs spanning food, nutraceuticals, cosmetics, and related sub sectors.

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Summary of Key Findings

The findings showed a consistent pattern across very different organisational settings. Participants described a scheduling architecture built around grouping halal production together and treating the changeover window as a protected, largely non-negotiable buffer, even when that protection required real negotiation under commercial pressure. Two risks stood out most clearly, pressure from upstream commercial decisions compressing changeover time, and the unpredictable availability of trained halal verifiers, particularly on night shifts and during peak demand periods. In response to these risks, participants described a layered set of strategies, formal SOPs and sign off requirements sitting alongside an inventive layer of informal, protective practices that reduced wasted time without touching the verification steps themselves.

Taken together, these findings support the central argument of this study, that scheduling deserves recognition as a distinct and significant halal integrity risk factor in its own right, one that lives at the intersection of commercial pressure, human availability, and the everyday discipline of shop floor practice.

Contributions of the Study

This study makes three contributions. Academically, it extends the largely conceptual scheduling literature represented by Kasdi et al. (2025) with grounded, first person evidence from the Malaysian SME manufacturing floor, and it demonstrates that both Theory of Constraints and institutional theory offer useful, complementary lenses for understanding how halal integrity risk concentrates around the changeover process. Practically, it identifies specific, low cost interventions, better use of historical cleaning time data, earlier involvement of compliance staff in commercial scheduling decisions, and guaranteed verifier coverage across all shifts, that SME owners and planners could reasonably act on without major capital investment. For policy, it offers JAKIM and related agencies grounded evidence that could inform more specific guidance on changeover standards and verifier availability, building on the National Halal Policy's existing direction toward tighter, more granular supply chain oversight.

Recommendations

Recommendations for SME Practitioners

SME owners and production planners are encouraged to move away from fixed, generic changeover standards and instead build scheduling capacity around actual historical cleaning and changeover data specific to each product pairing, since several participants in this study described exactly this shift after being caught out by unrealistic standard times. Halal compliance staff should be involved at the point where sales and commercial teams are negotiating delivery dates, not only at the point of final changeover sign off, since so much of the pressure participants described had already been locked in by the time production became aware of it. Finally, SMEs should treat verifier coverage as a scheduling requirement in its own right, ensuring every shift, including nights and weekends, has a trained halal executive or a clearly authorised deputy available, rather than assuming daytime coverage is sufficient.

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Recommendations for Policy and Regulatory Bodies

JAKIM and related agencies may wish to consider incorporating more explicit scheduling related criteria into audit guidance, moving beyond a general expectation of segregation toward clearer expectations around changeover duration standards and shift level verifier coverage. Given how often participants traced scheduling pressure back to commercial decisions made before production was consulted, industry associations could also play a useful role in developing shared guidance or training aimed specifically at sales and commercial staff in halal certified SMEs, a group not typically included in halal compliance training but shown in this study to meaningfully shape the risk environment production must then manage.

Recommendations for Future Research

This study opens several doors rather than closing them, and the wider body of Malaysian halal supply chain scholarship points to a number of directions worth pursuing next.

The most immediate direction concerns scale and disruption. The findings here identified commercial pressure and staffing gaps as the two dominant scheduling risks, and this sits comfortably alongside a growing stream of work on halal supply chain risk and resilience. Johan et al. (2025) mapped the wider landscape of risks facing halal supply chains and the strategies firms use to mitigate them, Rahim and Ibrahim (2025) showed how climate related disruption forces difficult rescheduling decisions in halal agriculture, Sufi et al. (2025) proposed an integrated resilience and adaptation framework for retailers responding to food supply chain disruption, and Anis et al. (2025) examined labour dynamics and operational efficiency as a distinct source of vulnerability. A natural next step would be to test whether the scheduling specific risks identified in this study, particularly verifier availability, hold up as a distinct category within these broader resilience frameworks, and Ahmad and Ibrahim (2025) offer a useful adjacent direction by examining service operations more broadly across the halal supply chain.

A second direction concerns whether the informal, low-cost coping strategies observed among participants in this study could be formalised into leaner, greener operating models. Wan Ab Aziz et al. (2026) recently examined halal lean practice directly among Malaysian SMEs, and this pairs naturally with the earlier conceptual groundwork on halal green supply chain management laid out by Ibrahim et al. (2020) and with Johan et al.'s (2019) study of lean production determinants in Malaysian manufacturing more broadly. Future research could usefully test whether the scheduling behaviours described by participants in this study, grouping products, staging tools, protecting changeover time, actually function as a form of lean practice, and whether environmental management adoption models developed by Ibrahim and Jaafar (2015, 2016a, 2016b), together with more recent SME focused work by Jamil et al. (2023) and workplace productivity research by Rahmat et al. (2023), could be extended to explicitly incorporate halal compliance as a sustainability outcome rather than treating it separately. Muhammad et al.'s (2023) work on the role of logispreneurs in reverse logistics and waste management also suggests an underexplored angle, whether SMEs managing shared halal and non halal lines could apply similar reverse logistics thinking to material segregation and waste handling during changeovers.

A third and particularly promising direction concerns digital enablement. Participants in this study repeatedly wanted a scheduling system that would refuse to release a risky sequence without compliance sign off, and this ambition connects directly to Rahim et al.'s (2025) work on blockchain enabled halal traceability in broiler supply chains and to the industry 4.0 halal supply chain framework proposed by Nurshafaaida et al. (2020). Amer and Ibrahim (2025) further extended this technological direction into artificial intelligence applications for halal supply chain marketing, and Jamaluddin and Rahmat (2022) demonstrated the growing role of artificial intelligence more broadly across travel, tourism, and hospitality operations, a parallel worth drawing on when designing decision support tools for halal manufacturing. Earlier work by Ibrahim et al. (2019) on digital logistics tools in mass marketing communication and Amer et al. (2019a) on brand love co-creation in digitalised supply chains further suggests that digital transformation in this space cannot be treated as a purely technical exercise, since it is also a communication and change management challenge. Future research could usefully design and pilot a scheduling decision support tool along these lines within a small number of Malaysian SMEs and evaluate its effect on changeover discipline directly.

A fourth direction concerns how far these findings travel beyond Malaysia's borders and beyond the Muslim consumer base already well served by the domestic market. Razak et al. (2025) examined the cultural sensitivity and globalisation challenges halal supply chains face in multicultural markets, Sarbani and Ibrahim (2025) explored the opportunities and challenges of expanding halal supply chains into Sub-Saharan Africa and Latin America, and Othman et al. (2025) reviewed China's halal supply chain development in relation to the Sustainable Development Goals. Read alongside Manan et al.'s (2019) study of urban Malaysian Malay consumers' willingness to accept foreign halal foods and Amer et al.'s (2019b) work on brand preference in the Muslimah fashion industry, these studies suggest that scheduling and changeover discipline, the operational backbone this study has focused on, may need to be studied differently again once Malaysian halal SMEs begin exporting into markets with different regulatory expectations and consumer trust dynamics. This represents a natural extension of the present study's SME focus into an export readiness and market entry context.
Finally, several strands of adjacent operations and management literature point to methodological and contextual extensions worth pursuing. Saleh et al. (2019) examined the technological, organisational, and environmental determinants of halal awareness within a broader risk management planning framework, which could be usefully combined with this study's scheduling focus in a future integrated model. Process improvement traditions represented by Zailani et al. (2023) on the Plan-Do-Check-Act cycle, Ibrahim et al. (2011) on total quality management practices, and Sundram et al. (2019) on order picking and packaging inefficiencies in a Malaysian pharmaceutical company all suggest established quality improvement methodologies that have not yet been applied specifically to halal changeover scheduling but plausibly could be. Nasir et al. (2021) examined the determinants of preferred export logistics gateways in Malaysia's halal product industry, a useful companion study for any future research extending this study's scope into transportation and export logistics. Broader institutional and organisational performance research, including Jaafar et al. (2009) on the commercial vehicle rebuilt industry, Perera et al. (2022) on enterprise risk management in higher education institutions, and Jalil et al. (2021) on the relationship between technological advancement and Malaysia's decarbonisation trajectory, together with Ibrahim et al.'s (2020) study of e-business adoption in hospitality operations sustainability, offer methodological templates, particularly around indicator development and multivariate analysis, that future quantitative follow up studies to this qualitative work could draw upon, should the field move toward testing the themes identified here across a larger sample.

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Taken as a whole, these directions suggest that scheduling in halal supply chains sits at a genuinely fertile intersection of resilience, lean and green operations, digital transformation, and international market expansion, and this study's phenomenological findings can serve as a grounded starting point for any of them.

Final Reflection

This study set out to give scheduling the kind of direct, grounded attention it has rarely received in Malaysian halal supply chain research, and in doing so, it has tried to let the people who actually live inside these schedules speak for themselves rather than being spoken about in the abstract. What comes through most clearly across all fifteen interviews is not carelessness or indifference toward halal compliance, but a group of committed practitioners working, often quietly and informally, to protect something they clearly believe matters, even when the pressures around them make that protection genuinely difficult. If this study accomplishes nothing else, it hopefully makes the case that scheduling is not a minor operational detail sitting at the edge of halal supply chain research, but one of the places where halal integrity is most concretely won or lost, one changeover at a time.

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