

# Digitization strengthens execution integrity in Bangladesh RMG: PRISMA review integrating Lean Six Sigma, TOC, and CEP.

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**Abstract:** Bangladesh RMG costs, lead-time pressure, digital-lean gains cannot be maintained unless adopted daily. The evidence-based systematic literature review is the synthesis of evidence that could enable to comprehend how Lean Six Sigma, and Theory of Constraints respond to the digitization processes to provide the improvement of the performance of operations in the environments that fall within the scope of the analysis in the RMG. It was performed in a PRISMA-based methodology. The synthesis is finalized by adding nine articles that are synergistic when it comes to (i) improvement routines and outcomes, (ii) digitization mechanisms such as alignment of ERP/ manufacturing execution systems and visibility of operations, (iii) critical success factors such as leadership, training, and measurement discipline. The key theoretical contribution of the review is that the concept of execution integrity which refers to the degree that the intentions of improvement are transformed into realistic everyday behavior backed up by shared operational information and binding control policies. After synthesis, the paper gives a conceptual framework of CEP, which advances digitization to the next position of execution ability layer (interoperability, data integrity, visibility, analytics readiness) that strengthens the execution integrity and optimizes the effects (lead time, defects, throughput, delivery reliability and compliance traceability).

**Keywords:** Lean Six Sigma; Theory of Constraints; PRISMA systematic literature review; Digitization; execution integrity in Bangladesh RMG;

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## I. INTRODUCTION

The RMG industry in Bangladesh is a massive and highly labor-intensive system of manufacturing which is incidentally under enormous pressure of operations. The factories are required to produce high speeds, level quality, and have record proof. Teams frequently deviate to firefighting when responding to pressure in which temporary gains are made in short projects which eventually fall apart.

Lean is widely used in the factories to enhance flow and minimize waste. They employ LSS to minimize variation by disciplining measurement. They occasionally employ TOC to enhance throughput with

the process of controlling constraints. Simultaneously, numerous factories are also investing in digitization, e.g. ERP, MES, dashboards, and Industry 4.0 tools.

It is not just the issue of technology adoption. The main issue is whether execution daily is based on intent to improve. Shadow systems (as spreadsheets and informal messaging) are constructed by the teams when the data is late, incomplete or untrusted. This disrupts data integrity and improvement routines.

Research Question: What is the interaction between Lean/LSS/TOC improvement routine and digitization mechanism to produce sustainable operational

performance in labor-intensive manufacturing setting applicable to Bangladesh RMG?

## II. RELATED WORK

There are a number of related streams in which digitization and continuous improvement were researched.

- 1) MES-Lean alignment: MES generates value when the logic of it is aligned to Lean goals such as flow, standard work, and WIP discipline [11].
- 2) IT as a Lean enabler: IT facilitates Lean where alignment, system fit, and adoption are considered [12].

3) Lean 4.0: Digital tools enhance feedback and visibility of Lean environments [13].

4) ERP integration backbone: ERP incorporates the primary processes and information flow among functions [14].

5) Industry 4.0 preparedness and obstacles: Bangladesh-specific research emphasizes the point that the benefits of the industry 4.0 are contingent on preparedness and obstacles [18], [19].

6) Data governance and data quality: Governance establishes the rights and responsibilities of data [8]. The quality of data has to be fit to use [9].

Table I. Comparison with Prior Work (Selected)

Study	MES–Lean Alignment	ERP Integration	Data Governance	Bangladesh RMG Focus
Cottyn et al. [11]	Yes	No	Indirect	No
Pinho & Mendes [12]	Indirect	Indirect	Indirect	No
Miqueo et al. [13]	Indirect	No	No	No
Arredondo-Soto [14]	No	Yes	No	No
Mim et al. [18]	No	Indirect	Indirect	Yes
Salman et al. [19]	No	Indirect	Indirect	Yes
This work	Yes	Yes	Yes	Yes (framework focus)

## III. KEY CONTRIBUTIONS

The paper contributes to the existing knowledge in three tangible ways.

- 1) Mechanism focus: It conceptualizes the integrity of execution as the key mechanism that can explain the reasons why digitization can lead to permanent improvement and sometimes flops [8], [9].
- 2) Evidence synthesis: It provides a summary of evidence on the importance of ERP/MES alignment,

interoperability and visibility in facilitating Lean/LSS/TOC routines [11]-[14].

3) Integrated CEP framework: It suggests a model Capability-Execution-Performance and a sequencing roadmap of the labor-intensive apparel factories.

## IV. METHOD (PRISMA-ALIGNED SYSTEMATIC LITERATURE REVIEW)

This paper is based on the PRISMA 2020 reporting principles [1], [2]. The review design is based on the

systematic review methodologies [3] and citation chasing and snowballing where required [4], [5].

A. Scope and Research Questions 2000 -2025 publications are reviewed and deal with the system of improvements (Lean, LSS, TOC), digitization mechanisms (ERP, MES, dashboards, Industry 4.0 tools), and outcomes (lead time, defects, throughput, delivery reliability, and compliance support).

B. Information Sources and Search Logic: Major academic sources and major blocks of keywords were used to identify the records. The snowball and citation chasing were used to increase coverage [4], [5].

C. Eligibility Criteria: To be eligible, the manufacturing/transferable production-flow context

was required, substantive Lean/LSS/TOC content, a clear digitization mechanism (or high relevance) which had to be published between 2000-2025.

D. Screening and PRISMA Counts: Records identified: 92; duplicates removed: 7; title/abstract excluded: 53; full texts assessed: 32; full texts excluded: 23; final included in synthesis: 9.

E. Quality Appraisal and Data Extraction: There was the use of 10-item checklist (score 0-10). The studies with a minimum score of 6 were retained. Fields that were extracted were study type, routines, mechanisms, outcomes, barriers, success factors, and mechanism statements [6], [7].

### PRISMA flow (summary)

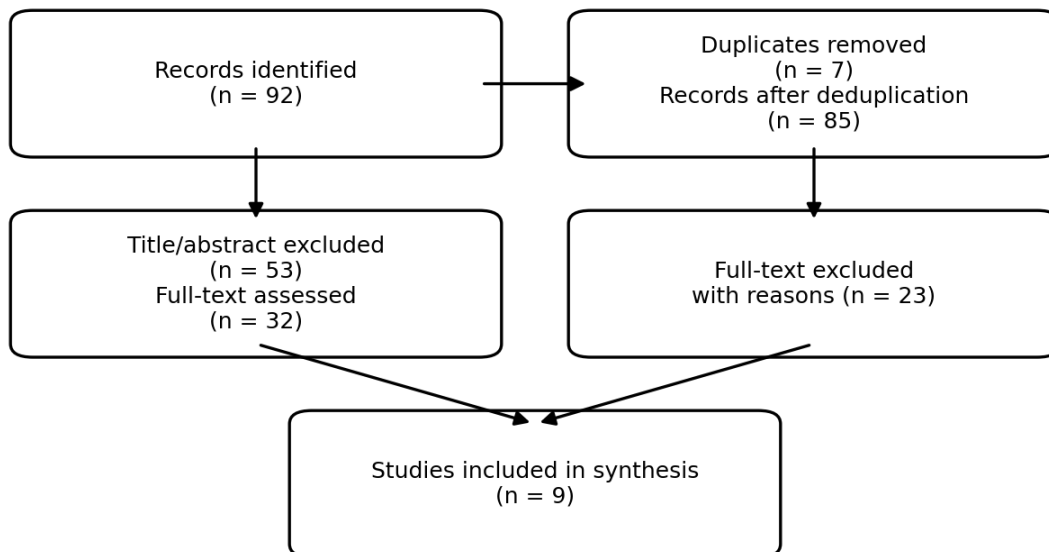


Figure 1. PRISMA flow diagram (summary).

## V. RESULTS

A. Routine and results improvement: Lean is the most predominant routine outlined, primarily as flow discipline, standard work, and WIP control. LSS is manifested primarily in measurement and governance requirements [20]. TOC relies on the high-quality indicators regarding constraints and WIP.

Typical results are reduction in lead time, reduction in defects, improvement in throughput and higher

delivery reliability in cases where there is a matching of planning and execution data [12], [14].

B. Digitization mechanisms: The support is found in digitization being an execution enabler. MES should encode Lean rules [11]. ERP facilitates inter-functional coordination [14]. The tools of visibility enhance feedback loops [13]. Bad fit promotes shadow reporting and poor adoption [12].

C. Barriers and success factors: The success factors that have been repeated are leadership commitment, skills and training, KPI discipline, and governance [8], [20].

The barriers in Bangladesh RMG are low trust in data, disjointed systems, poor interoperability, and readiness barriers [18], [19].

D. Gaps: Rarely do Bangladesh RMG empirical studies combine improvement routines, digitization mechanisms and performance outcomes in a single model [6], [7].

**VI. DISCUSSION**

A. The implementation of integrity into the formulated mechanism: Long-term value is acquired through digitization enhancing the execution integrity. Execution integrity implies consistency of

improvement as daily decisions based on legitimate data and enforceable guidelines [8], [9], [11], [12].

B. Capability-Execution-Performance (CEP) model: the definition of what has to be better is provided in Lean/LSS/TOC. Digital capability ascertains the extent to which that intent is executed daily. Performance results are then motivated by execution integrity.

C. Practical sequencing road map: The factories are able to sequence the work by stabilizing KPI definitions and governance, then standard work and visual control, then ERP- MES alignment and lastly constraint protection and sustainment cadence.

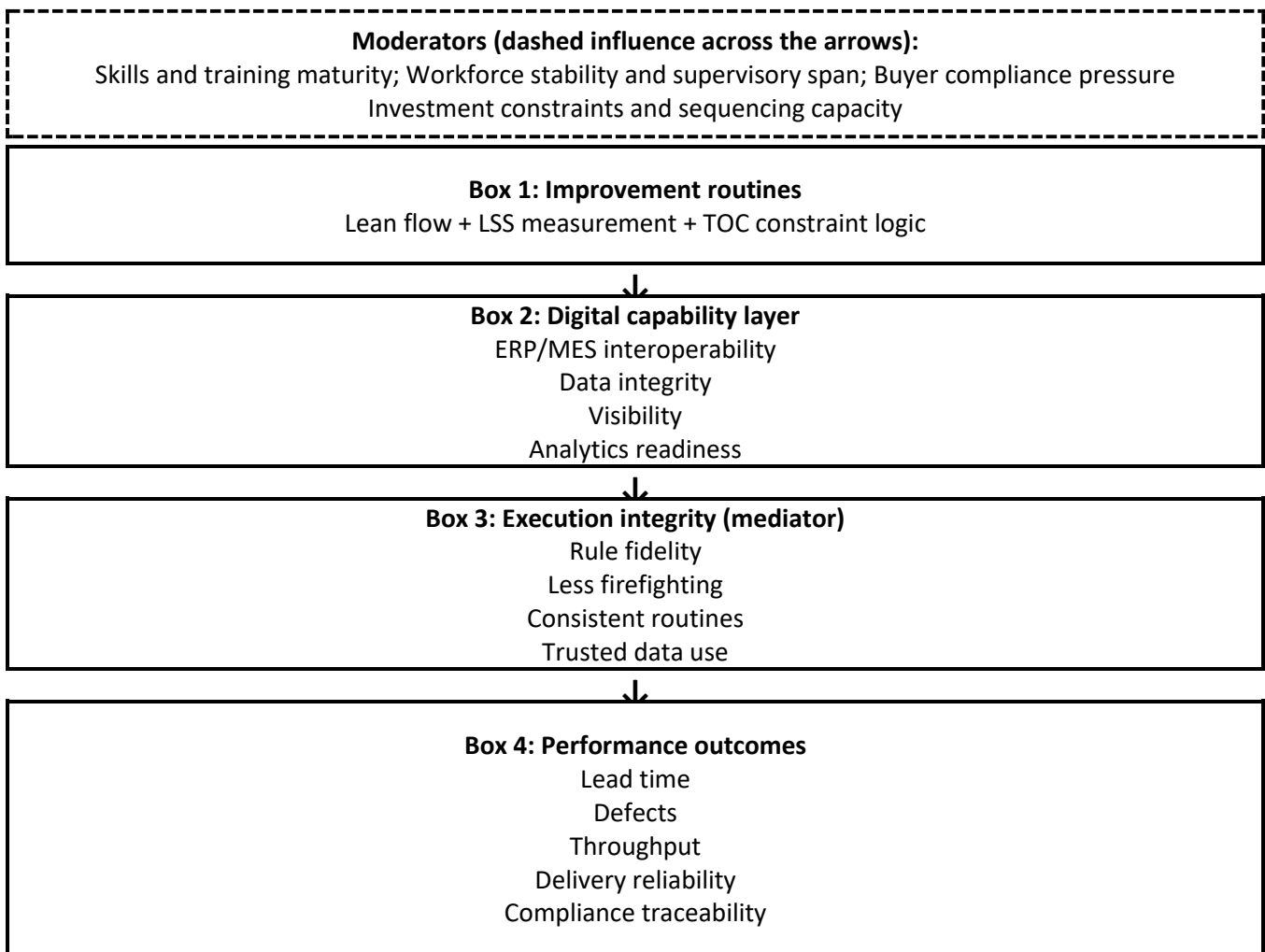


Figure 2. Capability-Execution-Performance (CEP) framework (Summary).

Table II. Practical Roadmap Aligned to CEP

Phase	Goal	What to Implement	Key Risk	Simple Control
1	Create a KPI spine	Definitions and audit rules	KPI manipulation	Audit sampling
2	Stabilize work	Standard work and visual control	Supervisor overload	Short daily checklists
3	Align systems	ERP orders and MES line status	Shadow reporting	Remove duplicates
4	Protect constraint	Constraint visibility and buffers	Wrong bottleneck	Weekly review
5	Sustain	Cadence, training, and governance	Routine decay	Closure-rate tracking

## VII. CONCLUSION

1) Solved problem: investments around labor-intensive apparel digitization in many cases fail to generate lasting returns since daily implementation is not a reliable course of action after the improvement has been intended.

2) Approach A PRISMA-compliant systemic literature review and screen transparency, quality evaluation and mechanism-based synthesis [1]-[3].

3) Important insights: Sustained value occurs when execution integrity goes up because of digitization. The main mechanisms are ERP-MES interoperability, MES- lean alignment, and data integrity, and operational visibility [11], [12], [14]. It is explained by governance and fit-for-use data quality in terms of adoption and trust [8], [9]. The benefits of Bangladesh RMG are influenced by the readiness and barriers to adoption [18], [19].

4) Limitations and future work: There are limited studies about Bangladesh RMG empirically which test routines and mechanisms together with their outcomes. The future research should involve CEP propositions on field data and longitudinal designs.

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