



Talent Management in Upskilling for Data-Driven Supply Chain Orientation in the Era of Industry 4.0. : A Conceptual Model for the Ready-Made Garments Industry of Bangladesh.

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Abstract

Bangladesh’s ready-made garments (RMG) industry—the country’s dominant export sector—is digitising rapidly, adopting enterprise resource planning (ERP) systems, Internet of Things (IoT) monitoring, and analytics-driven production control to safeguard its global competitiveness ahead of graduation from Least Developed Country status. However, the main limitation of this digital investment lies not in technology but in a shortage of human capital with strong updated skilled talents. This paper develops a literature-driven conceptual framework explaining how strategic talent-management interventions mediate the relationship between Industry 4.0 infrastructure and data-driven supply chain performance in the RMG context. Drawing on the Resource-Based View and Dynamic Capabilities Theory, and synthesising peer-reviewed operations and human-resource scholarship with secondary sectoral and macro-labour evidence, the study (a) specifies the technical, cognitive, and behavioural competencies underpinning Data-Driven Supply Chain Orientation (DDSCO) in apparel manufacturing; (b) proposes a mediation–moderation model in which structured upskilling translates technological capability into operational outcomes, conditioned by organisational data culture; and (c) derives testable propositions for future empirical validation. The framework offers RMG manufacturers and policymakers a structured blueprint for transitioning an operationally oriented, predominantly female workforce toward data literacy, while addressing the documented risks of automation-driven displacement.

Keywords: Talent Management; Industry 4.0; ready-made garments; Bangladesh; supply chain analytics; upskilling; data-driven supply chain orientation; dynamic capabilities

1. Introduction

The conventional supply chain management (SCM) has been transformed by the diffusion of Industry 4.0 technologies into a highly integrated, data-driven system in which forecasting, inventory, and logistics decisions are increasingly automated and analytics-led (Kamble et al., 2020). The integration of cyber-physical systems, sensor networks, and predictive analytics has increased the amount and speed of supply chain data, demanding a workforce capable of interpreting and acting on ongoing information flows (Waller & Fawcett, 2013). As a result, the main challenge in realising value from

digital investments is now the human capital capable of guiding it, rather than the hardware or software (Wamba et al., 2015). This tension is especially significant in Bangladesh's ready-made garments (RMG) industry. The sector accounts for the overwhelming majority of national export earnings of the country and employs approximately four million workers, most of whom are women (BGMEA, 2024). RMG manufacturers are rapidly adopting ERP systems, IoT-based production monitoring, and data analytics due to the potential loss of preferential trade access after graduating from Least Developed Country status, as well as international buyers' demands for greater efficiency and traceability (Apparel Resources, 2025; The Daily Star, 2026). The key issue for the sector has shifted from whether to digitise to whether its workforce can be reskilled swiftly enough to operate these systems and derive value from them.

Although RMG companies are adopting more digital SCM tools, a continuing talent mismatch reduces the benefits of these investments. Employers worldwide consider the skills gap as the most significant obstacle to business transformation (World Economic Forum, 2025). In the Bangladesh's RMG context, the gap is significant and well documented. A survey of 142 Bangladeshi factories found an overall Industry 4.0 maturity of just 1.91 on a five-point scale, indicating low adoption, with digital integration the weakest dimension (Mim et al., 2024). Salman et al. (2024), through a Delphi–DEMATEL analysis, identified 'Industry 4.0 training,' lack of motivation, and resistance to change as the top barriers impeding adoption in the sector—highlighting workforce capability as the key issue over capital. A case study reported staff skill gaps approaching 30%, although sector-wide estimates remain limited (Hosain, 2025). Moreover, a BIDS study found that the Bangladeshi RMG sector faces a skills gap exceeding 60%, particularly among machine operators, highlighting the urgent need for structured workforce development and job-specific training (RMG Bangladesh, 2023). Sector skill-gap analyses highlight shortages in both technical and managerial competencies (SEIP, 2021). At the same time, automation is already reshaping the labour profile, with reports of observable reductions in entry-level employment as factories upgrade (Bangladesh Labour Foundation, 2024). What is missing is a theoretically grounded blueprint connecting human-resource capability to the sector's evolving technical infrastructure.

The objective of the study is to identify the core competencies required for a Data-Driven Supply Chain Orientation (DDSCO) for companies in Bangladesh's RMG sector. The study also constructs a literature-driven conceptual framework that specifies how strategic upskilling mediates the relationship between Industry 4.0 technologies and supply chain performance for companies in Bangladesh's RMG sector. The paper also identifies the necessity of targeted talent-management architectures for companies in Bangladesh's RMG sector.

The study integrates two strategic-management traditions, the Resource-Based View (RBV) and Dynamic Capabilities Theory, into a single mediation–moderation model tailored to the RMG sector. The model is conceptual and literature-driven, synthesising peer-reviewed evidence and secondary sectoral data. The framework is intended to guide subsequent empirical testing within RMG firms and practitioner decision-making. While focused on Bangladesh's apparel sector, the logic is transferable to comparable labour-intensive export industries undergoing digital transformation.

2. Theoretical Foundations

The theoretical framework rests on two complementary theories. The Resource-Based View explains why analytically capable talent constitutes a source of sustained advantage; Dynamic Capabilities Theory explains how firms continually reconfigure that talent in response to technological change.

Based on the RBV, an organisation's resources confer a sustained competitive advantage if they are valuable, rare, inimitable, and non-substitutable (VRIN) (Barney, 1991). In the RMG sector, while

ERP platforms and automated machinery are becoming widely accessible to well-funded competitors and can be easily copied, it is the analytics-skilled workforce that manages and enhances these systems. This workforce fulfils the VRIN criteria and maintains a competitive edge by resisting imitation (Yu et al., 2019). Furthermore, empirical work confirms that data-driven supply chain capabilities, grounded in human and organisational resources, are positively associated with supply chain responsiveness and financial performance (Chavez et al., 2017).

Dynamic capabilities are a firm's capacity to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments (Teece et al., 1997). In the RMG context, dynamic capability manifests as the organisational ability to continually upskill and realign workers as new machinery, monitoring systems, and analytics tools are introduced. While the RBV considers talent a key strategic asset, Dynamic Capabilities Theory outlines a renewal mechanism that involves structured, ongoing learning to ensure the asset continues to hold value as technologies evolve.

2.1 Conceptualising Data-Driven Supply Chain Orientation (DDSCO)

Data-Driven Supply Chain Orientation signifies a company's strategic focus and cultural alignment to utilising real-time data analytics at every point of the supply chain (Yu et al., 2019). For an RMG manufacturer, DDSCO covers demand forecasting, production-line monitoring, supplier performance assessment, and buyer-facing traceability and compliance reporting. It embodies both technology and behaviour, needing robust analytical infrastructure and a workforce and management culture focused on evidence-based decision-making. The human foundation of DDSCO rests on three interdependent pillars of competence (Table 1).

Table 1: *The Three Competence Pillars of DDSCO in the RMG Context*

Technical competencies	Cognitive competencies	Behavioural competencies
ERP operation (e.g., SAP/Oracle); production-line IoT and machine monitoring; predictive demand analytics; basic Python/SQL; digital compliance and	Systems thinking; interpretation of production and quality data; scenario and risk reasoning; root-cause problem-solving	Data advocacy; agile cross-functional collaboration; communication between floor supervisors and analysts; continuous-learning orientation

Note. Synthesised from World Economic Forum (2025), Kamble et al. (2020), Miah et al. (2024), and RMG sector evidence (SEIP, 2021; Hosain, 2025).

2.2 Talent Management as the Connective Mechanism

A recurring theme across operations and human resource development scholarship is that technological adoption alone is insufficient for performance gains; complementary investment in workforce capability and organisational culture is required to convert technology into value (Wamba et al., 2015; Dubey et al., 2020). Dubey et al. (2020) show that organisational culture and big-data orientation operate as complements rather than substitutes, implying that talent interventions are most effective where a supportive data culture already exists. This complementarity motivates the mediation-moderation logic of the present framework, and it resonates with RMG-specific findings that effective training and development materially improve worker performance (Rabbi et al., 2024), while a lack of organised training remains a binding constraint on technology adoption (Salman et al., 2024).

3. Methodology

This study uses a qualitative desk research approach based on literature, suitable for developing conceptual theories. The approach proceeds in two integrated streams. Initially, a systematic review

of peer-reviewed literature in operations management and human resources sourced from Scopus, Google Scholar, and top logistics and management journals was conducted to identify the key constructs and their relationships forming the framework. Second, authoritative sources such as the World Economic Forum's Future of Jobs Report 2025, BGMEA statistics, sector skill-gap analyses, and recent RMG digital-transformation studies were used to synthesise secondary sectoral and macro-labour evidence. This process aims to confirm the framework's empirical need and ensure its relevance within the apparel industry.

Thematic content analysis and secondary synthesis were used to identify the variables that influence successful talent upskilling within automated apparel-manufacturing networks (Dubey et al., 2020). Constructs appearing in multiple independent sources were kept and categorised into independent, mediating, moderating, and dependent groups. Sectoral figures obtained from single case studies or industry reports are reported as indicative rather than as established population estimates and are attributed to their sources accordingly. As a conceptual study, the design specifies a model and propositions for subsequent empirical testing rather than directly estimating relationships.

3.1 Inclusion and exclusion criteria

Peer-reviewed and authoritative institutional sources (2013 onward) addressing the framework's constructs were included; notably Barney (1991) on the Resource-Based View and Teece et al. (1997) on dynamic capabilities were retained on the basis of their seminal status. Non-peer-reviewed commentary, vendor content, and untraceable material were excluded, while single-case sectoral figures were admitted only as indicative evidence (Hosain, 2025). Constructs were retained only when they appeared in multiple independent sources, so isolated or unsubstantiated claims were excluded from the model.

A source was excluded where it failed to meet these conditions. Material was set aside if it was tangential to the framework's constructs, lacked methodological transparency, or could not be traced to an identifiable and credible author or institution. Opinion pieces, promotional or vendor content, and non-peer-reviewed commentary were excluded except where used, with attribution, to illustrate practitioner or industry perspective.

3.2 Literature-Driven Conceptual Framework

The proposed model positions strategic talent management as the mediating mechanism connecting Industry 4.0 infrastructure to data-driven supply chain performance in RMG firms, with organisational context acting as a moderator.



Figure 1: A framework of Talent Management in RMG Industry 4.0 Supply Chains

Note. The conceptual logic runs $X \rightarrow M \rightarrow Y$, with the moderating context conditioning the $M \rightarrow Y$ path.

4. Discussion and Analysis

4.1 Global Talent Trends and the RMG Imperative

Global labour-market evidence underscores both the scale of skill disruption and the centrality of the skills gap. Drawing on more than 1,000 employers representing over 14 million workers across 55 economies, the World Economic Forum (2025) reports that 86% of employers expect artificial intelligence and information processing to transform their operations by 2030, and that 63% identify the skills gap as the foremost barrier to transformation. On average, 39% of workers' core skills are expected to change over 2025–2030—down from 44% in 2023—a moderation attributed in part to expanded reskilling, with 50% of workers having completed training measures compared with 41% in 2023. Analytical thinking remains the most sought-after core skill, while AI and big data top the list of fastest-growing skills. For an export sector competing on cost, speed, and compliance, these trends translate into direct pressure to build analytical capability.

4.2 Digital Transformation in the RMG Sector

RMG manufacturers have moved relatively quickly on ERP systems, digital monitoring, and compliance platforms, although adoption of AI and immersive training remains at an early stage compared with competitors such as China and Vietnam (Apparel Resources, 2025). The sector's overall readiness, however, is still maturing: applying an Analytical Hierarchy Process and fuzzy inference readiness model to a Bangladeshi garment firm, Faisal et al. (2024) placed the case company at a "Survival" stage (readiness 0.66 of 1.0), identifying planning and strategy as the dimension most constraining further progress. Indicative findings from a single-firm case study suggest that IoT deployment can reduce lead times by roughly 10–15%, blockchain can improve traceability, and ERP can reduce order errors, while also documenting staff skill gaps near 30%, high implementation costs, and infrastructure constraints such as power interruptions (Hosain, 2025). These firm-specific figures derive from single exploratory cases and benchmarked estimates and should be read as indicative of direction rather than precise sector-wide effects, but across studies, they consistently identify workforce capability as a central adoption barrier.

4.3 The RMG Skills Gap and Workforce Transition

Sectoral skill-gap analyses reveal shortages in both technical and soft skills at operative and managerial levels, with managerial deficiencies including merchandising, communication, leadership, and decision-making (SEIP, 2021). at the same time, automation is transforming the labor landscape: a 2024 study of RMG workers found significant declines in entry-level roles like helpers as factories modernize. This highlights the importance of implementing "just transition" strategies that combine technological advancement with reskilling initiatives and equitable treatment for displaced workers (Bangladesh Labour Foundation, 2024). Since the workforce is mainly female, the impact of this shift is considerable. Targeted reskilling programs demonstrate that displaced or unemployed women can re-enter the digital supply chain when training matches employer needs (VF Foundation, 2024). Table 2 summarises the principal skill clusters and shortage profiles for the sector.

Table 2: *RMG Automation Skill Demand and Associated Shortages*

Skill demand cluster	Demand outlook	Primary skill shortage
ERP and digital compliance/traceability	Critical demand	ERP operation and customisation; data-quality management

Skill demand cluster	Demand outlook	Primary skill shortage
Production-line IoT, automation, and robotics	High growth	Machine-interface operation; maintenance and control
Demand and production analytics	High growth	Predictive modelling; interpretation of dashboards
Green and sustainability operations	Moderate growth	Lifecycle assessment; carbon and energy accounting

Source: Synthesised from SEIP (2021), Hossain (2025), Apparel Resources (2025), and World Economic Forum (2025). Demand outlook reflects qualitative direction reported across sources rather than single point estimates.

4.4. Strategic Imperatives for RMG Human-Resource Leaders

The framework implies that human-resource functions in apparel firms can no longer operate as administrative processing centres; they must act as strategic architects embedded within production and supply chain planning (Chavez et al., 2017). Two key strategic imperatives are essential. First, ongoing technical audits are necessary: HR leaders should assess the digital skills of line supervisors and floor managers, then develop targeted, modular training programs—covering machine operation and ERP systems—to address any skill gaps. Second, cross-functional integration should be institutionalised through rotational assignments between data analytics staff and frontline production planners, thereby building the shared understanding that a data culture requires (Waller & Fawcett, 2013).

5. Key Findings

This study suggests that technological adaptation in RMG supply chains offers limited benefits unless paired with human-capital development (Wamba et al., 2015). By combining the Resource-Based View and Dynamic Capabilities Theory, the framework highlights how structured talent-management interventions focused on data literacy, ERP skills, and systems thinking serve as the link that translates technological capabilities into supply chain performance. This process is influenced by the organisation's data culture and effective transition management. Secondary evidence, such as the World Economic Forum (2025) report and studies on RMG-specific skill gaps and digital transformation, supports the idea that the challenge is significant and emphasizes the importance of structured upskilling.

5.1 Policy Recommendations for the Sector

At the sectoral level, the analysis points to a need to align education and training systems with industrial demand. First, public–private curricula alliances—linking BGMEA, national engineering and business universities, and bodies such as the Skills for Employment Investment Program—should introduce specialised diplomas in apparel supply chain analytics and ERP operation, addressing the curricular mismatch documented in Section 4 (SEIP, 2021). Second, BGMEA and government can subsidise certified data-literacy and automation training, lowering the private cost of building a shared capability base across thousands of factories (Hossain, 2025). Third, given documented automation-driven displacement, policy should embed “just transition” safeguards so that productivity gains do

not come at the expense of the predominantly female workforce (Bangladesh Labour Foundation, 2024).

5.2 Limitations

Because the study relies on secondary data and literature-driven conceptualisation, it does not include primary statistical testing within a specific firm. Several sectoral figures derive from single case studies or industry reports and are therefore indicative rather than population estimates, as noted in Section 4. The synthesis is shaped by the coverage of available sources, and the framework's generalisability beyond the RMG context remains to be established empirically.

5.3 Directions for Future Research

Future research can implement the framework by collecting primary survey data from RMG firms and applying structural equation modelling to evaluate how talent interventions mediate outcomes and how data culture and transition support influence these effects. Comparative studies across different firm sizes, tiers, and competing apparel-exporting economies can clarify boundary conditions. Additionally, longitudinal research could track how evolving upskilling capabilities develop as automation advances. Implementing sector-specific applications, like testing the model in green-factory settings or fully ERP-integrated plants, would aid in converting the general model into practical, context-aware guidance.

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