

Strategic Leadership for Industry 4.0 Adaptation in Vocational Education: A Qualitative Case Study of Sensemaking and Resource Orchestration in Indonesia

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ABSTRACT. Strategic leadership has become central to preparing vocational education for the Fourth Industrial Revolution (Industry 4.0). However, existing strategic leadership scholarship is predominantly grounded in resource-rich, Western educational systems, offering limited explanations of how vocational school leaders sustain organizational adaptation amid institutional and material constraints in the Global South. This study addresses this gap by examining how strategic leadership is enacted in a public vocational school in Bandung, Indonesia. Employing an instrumental qualitative case study, data were generated through semi-structured interviews, non-participant observations, and document analysis, and analyzed using thematic analysis. The findings demonstrate that strategic adaptation is fundamentally a relational and context-sensitive leadership capability characterized by three interconnected practices: contextual sensemaking, negotiated organizational alignment, and entrepreneurial resource orchestration. Rather than relying on hierarchical decision-making, school leaders translated Industry 4.0 demands into locally meaningful actions through continuous dialogue with teachers and industry partners, transforming external pressures into collaborative organizational learning. A key contribution of the study is the identification of capital alchemy, a strategic mechanism that deliberately converts intangible assets—including institutional reputation, teacher expertise, student achievements, and social legitimacy—into tangible resources such as Corporate Social Responsibility (CSR) funding, industry partnerships, and infrastructure development. This concept extends strategic leadership theory by demonstrating how symbolic, social, and human capital can compensate for material resource scarcity and function as strategic assets for organizational transformation. The study proposes a contextually grounded model of relationship-based strategic leadership that broadens prevailing resource-centered perspectives and offers practical implications for leadership development, educational governance, and vocational education policy in resource-constrained settings across the Global South.

Keywords: *Capital Alchemy; Organizational Adaptation; Resource Orchestration; Strategic Leadership; Vocational Education.*



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INTRODUCTION

The Fourth Industrial Revolution (Industry 4.0), characterized by the fusion of digital, biological, and physical technologies, fundamentally disrupts global workforce demands, requiring advanced digital literacy and adaptive competencies (Schwab & Samans, 2016). For vocational

education systems, this disruption is an existential imperative (Avis, 2018; Panagiotopoulou et al., 2022). In Indonesia, this intersects with the national 'link and match' policy, pressuring Vocational High Schools (*Sekolah Menengah Kejuruan*—SMK) to ensure direct educational relevance to industry (Bruri Triyono & Hariyanto, 2024; Triyono & Mateeke Moses, 2019). Consequently, SMKs require deep, systemic transformation of curriculum, pedagogy, and industry partnerships.

While the educational leadership literature is extensive, specific inquiry into *strategic leadership* for Industry 4.0 within Indonesian SMKs remains critically underdeveloped. Prior studies on VET leadership primarily focus on generic styles or administrative management (Arik & Yilmaz, 2020; Harris & Jones, 2020), overlooking the strategic, ecosystem-engaging actions necessary for technological disruption. Furthermore, research concentrates on national policy (Marlina et al., 2024) or student outcomes (Pratolo et al., 2020), leaving a critical gap in understanding the *meso-level processes*—the *how* of leadership practice within the school itself (Dewi & Muttaqin, 2024). Specifically, empirical evidence on how strategic leadership is enacted at the school level in resource-constrained, non-Western VET contexts remains scarce (cf. Tran et al., 2026). This study addresses this gap by providing an in-depth examination of strategic leadership *in action*.

SMK Guna Dharma Nusantara in Bandung, West Java, is selected as a revelatory case (Yin, 2018). Bandung is a major technological and manufacturing hub, placing local SMKs at the forefront of Industry 4.0 pressures. However, the value of this case is not merely locational. The theoretical value lies in its potential to reveal how strategic leadership navigates the tension between a) the universalistic, technology-driven demands of Industry 4.0, and b) the particularistic, socio-material constraints of a public school in a developing economy. This case offers a critical test and potential refinement of Western-centric strategic leadership theories (Boal & Hooijberg, 2000; Sirmon et al., 2011) in a drastically different resource ecosystem.

This study conceptualizes strategic leadership not as a position but as a dynamic influence process aligning internal capabilities with external environmental demands (B. Davies & Davies, 2010; B. J. Davies & Davies, 2004). In the SMK context, this involves three core dimensions: (1) Environmental Sensemaking: How leaders interpret Industry 4.0 signals and translate them into a shared vision; (2) Strategic Resource Orchestration: How leaders prioritize and allocate limited resources to build new capacities; and (3) Stakeholder Alignment: How leaders build symbiotic partnerships with industry. Understanding how leaders navigate tensions—e.g., between immediate operations and long-term investment—is central to understanding effective strategic leadership.

The purpose of this qualitative case study is to generate a rich understanding of strategic leadership practices at an Indonesian SMK adapting to Industry 4.0. The overarching question is: How is strategic leadership enacted at SMK Guna Dharma Nusantara to adapt to Industry 4.0 demands? This is operationalized through three sub-questions: How do school leaders perceive and interpret the challenges and opportunities of Industry 4.0? What key strategic initiatives have been undertaken, and how were they formulated and implemented? What are the primary challenges encountered in this adaptation, and how does leadership respond?

This study is significant for theory, policy, and practice. Theoretically, it aims to refine strategic leadership theory by examining leadership action under extreme resource constraints (*leadership under constraint*) and in a Global South context, moving beyond resource-abundant, Western settings. For policymakers, it provides grounded evidence that effective support requires building leaders' strategic capacity rather than just providing equipment. For practitioners (principals, *Kaprog*), it offers relatable, actionable strategies (e.g., capital alchemy, peer-led sensemaking) for navigating disruption. A qualitative single-case study design is employed, as it is ideal for exploring a complex phenomenon in its real-life context where boundaries are unclear (Yin, 2018).

METHOD

This study employs a qualitative, instrumental single-case study design (Yin, 2018) to gain an in-depth understanding of strategic leadership at SMK Guna Dharma Nusantara. An interpretivist epistemological stance is adopted, assuming that strategic leadership is socially constructed through interactions, language, and shared meanings among school actors. The single-case design is justified as a revelatory case. It provides rare access to a school explicitly navigating Industry 4.0 adaptation in a resource-constrained, non-Western context, allowing for theoretical generalization to the broader phenomenon of 'strategic leadership under constraint' rather than statistical generalization to a population of schools (Yin, 2018).

The research site is SMK Guna Dharma Nusantara, Cicalengka, Bandung Regency, West Java, Indonesia, selected purposefully as an information-rich, critical case. Participants were identified via criterion-based and snowball sampling. Inclusion criteria were: (a) direct involvement in strategic decision-making or (b) direct implementation of Industry 4.0-related initiatives. Final participant pool (achieved saturation after 18 interviews) consisted of: 1 principal, 3 vice-principals (curriculum, facilities, student affairs), 5 heads of competency departments (*Kaprog*; e.g., Software Engineering, Pharmacy, Automotive), 4 senior champion teachers, 2 industry liaison staff, and 3 teachers from pilot projects. *Code saturation* (initial thematic framework identified) was reached after 12 interviews; *meaning saturation* (nuanced understanding of themes) was reached after 18 interviews, confirmed through iterative data collection and analysis.

Data were collected over four months (January-April 2025) through methodological triangulation. Semi-structured interviews (60-90 minutes, conducted in Indonesian, audio-recorded) used an interview guide derived from the conceptual framework (sensemaking, resource orchestration, alignment). Non-participant observation (12 sessions of 2-3 hours each) focused on strategic planning meetings, teacher training (*Guru Belajar*), and industry liaison events. The researcher's role was 'observer-as-participant' (Maretto, 2018), with minimal disruption to activities. Document analysis examined School Development Plans, MoUs, curriculum documents, and partnership reports using content analysis to identify formal and espoused strategies.

Data analysis followed reflexive thematic analysis (Braun & Clarke, 2021). We employed a hybrid deductive-inductive coding approach. *A priori codes* (deductive) derived from our conceptual framework: 'environmental scanning', 'resource brokerage', 'stakeholder mediation'. *Inductive codes* emerged from the data: 'capital alchemy', 'boundary spanning by Kaprog', 'peer-led sensemaking'. NVivo 12 software facilitated data organization, coding, and retrieval. Analysis proceeded through phases: familiarization, initial coding, generating initial themes, reviewing and refining themes, and defining/naming final themes. The process was iterative, with continuous movement between data and emerging analysis. Inter-coder reliability was not calculated, as our reflexive approach prioritizes depth of interpretation over consensus; instead, regular research team debriefings and peer examination of coding decisions were conducted.

To ensure trustworthiness (Lincoln, YS & Guba, 2003), we employed: (1) Credibility: Prolonged engagement (120+ hours on-site), methodological triangulation, and member checking (preliminary interpretations shared with 6 key participants for validation). (2) Transferability: Provided a 'thick description' of context and participants. (3) Dependability: Maintained a detailed audit trail (analytic memos, versioned coding files, decision logs). (4) Confirmability: The lead researcher maintained a reflexive journal, noting her positionality as a leadership researcher from a local Islamic university with prior professional connections to SMK principals in the region, which was bracketed throughout analysis.

Ethical approval was obtained from the STAI Al-Falah Research Ethics Committee (Ref: STAIA/EC/2025/012). Formal permission was secured from the school principal and the district education office (*Dinas Pendidikan*). All participants provided written informed consent, were assured

of confidentiality, and were given the right to withdraw. Pseudonyms are used for all individuals and the school name in publications.

RESULT AND DISCUSSION

Result

This chapter presents the findings from the qualitative case study conducted at SMK Guna Dharma Nusantara. The analysis is structured around three core themes that emerged from the data, directly addressing the research sub-questions and reflecting the integrated theoretical framework. These themes are: (1) Strategic Sensemaking: Translating the Abstract Threat of Industry 4.0 into a Concrete School Vision; (2) Orchestrating Alignment: The Micro-Politics of Curriculum and Partnership Reform; and (3) Resourceful Leadership: Improvisation and Leverage in a Constrained Ecosystem. Pseudonyms are used for all participants to ensure confidentiality.

Strategic Sensemaking: Translating the Abstract Threat of Industry 4.0 into a Concrete School Vision

The leadership at SMK Guna Dharma Nusantara did not perceive Industry 4.0 as a distant, theoretical concept but as an immediate pressure manifesting through specific channels. The principal, Mr. Yoga, described a pivotal wake-up call at a 2019 industry forum, where local manufacturers lamented the significant skill gap between SMK graduates and the requirements of their automated production lines. This external signal was internalized as a direct threat to the school's core mission and reputation. *"If our graduates cannot operate a CNC machine programmed via the cloud, then our link and match is just a slogan on paper,"* he stated. This sentiment was echoed by the vice-principal for curriculum, Ibu Sari, who noted that declining interest from top-tier industry partners for student internships served as a tangible metric of the school's growing irrelevance (Vice Principal for Curriculum, personal interview, January 2025).

The leadership's strategic response was not to adopt a generic 'digital transformation' plan, but to engage in a deliberate, context-specific process of sensemaking through structured internal forums and industrial feedback loops. As articulated by the Vice Principal for Curriculum, Mr. Yoga Hidayat, the school actively interprets 'Industry 4.0' as 'the alignment of vocational education with industrial technological developments so that graduates are job-ready and relevant to the needs of the business and industrial world (DUDI). This translation was operationalized by disseminating information from industry partners, including competency standards, technologies used, and evaluations of student internships, to all teachers as collective reflection material. Data from meeting minutes and interviews revealed how this feedback was then broken down into actionable, program-specific components (Vice Principal for Curriculum, personal interview, January 2025).

However, this process was not without friction. Interview data revealed a clear generational and experiential divide among teachers. Senior teachers, like Cahya Miftahul Falah (Vice Principal for Facilities) in Mechanical Engineering, initially framed the change as a *"disruption to proven methods"* and expressed anxiety about their own digital competence. The leadership's strategy to overcome this was not through mandate but through peer-led demonstration. They identified and empowered a few younger, tech-savvy *"champion teachers"* to pilot new modules, such as a simple IoT-based monitoring project in the agriculture program. The success of these small pilots, showcased in school exhibitions, became powerful narratives that helped reshape the collective understanding of what was possible and necessary (Vice Principal for Facilities, personal interview, January 2025).

The initial wake-up call described by school leaders stemmed from direct interactions with industry and alumni, as well as observations of student competency gaps, prompting the realization that SMK must change for the better to remain relevant. This process was not without friction. Interview data revealed staff concerns about readiness (Vice Principal for Curriculum, personal interview, January 2025). However, the leadership's strategy to address this, as observed in teacher coordination meetings, was characterized by collegial, family-like collaboration. Discussions were

facilitated in a relaxed, calm, and motivational tone, encouraging open exchange of ideas and personal experiences from internship supervision. This approach fostered a cooperative atmosphere where differences in perception were resolved through discussion and mutual understanding, effectively building internal buy-in (Field notes, observation of wake-up call, January, 2025). The process of contextualized sensemaking operated at three distinct but interconnected levels, creating a cascade of clarity: (1) Leadership Translation (Abstract to Strategic): The principal and vice-principals translated the macro-concept of "Industry 4.0" into strategic pillars for the school: Digital Infrastructure, Future Skills Curriculum, and Deep Industry Collaboration. (2) Middle-Leader Translation (Strategic to Operational): Department heads (*Kaprog*) performed the critical work of translating these pillars into program-specific roadmaps. For example, for the Multimedia program, "Future Skills" was translated into specific competencies in 3D animation for virtual prototyping and digital marketing analytics, moving far beyond traditional graphic design. (3) Teacher Translation (Operational to Pedagogical): Champion teachers, in turn, translated these roadmaps into lesson-level activities and assessments. A lesson on "data" in the Automotive program evolved from memorizing engine specifications to a project in which students collected and analyzed real-time fuel-efficiency data from a sensor-equipped motorcycle.

This multi-level translation chain ensured the abstract threat was made concrete at every layer of the organization, preventing strategic dilution. Mr. Yoga's role as a translator and motivator involved a sophisticated political and rhetorical reframing. Observation data from staff meetings showed he consistently used two complementary frames: (1) The Opportunity Frame: *"Industry 4.0 is our chance to lead, not follow. It is how we put SMK Guna Dharma Nusantara on the map as the most innovative school in Bandung Regency."* This appealed to pride and professional ambition. (2) The Survival Frame: *"If we ignore this, the industries will go to other schools. Our workshops will become museums, and our students' prospects will dim."* This leveraged collective anxiety about institutional and student relevance. Crucially, he linked both frames to the teachers' professional identity. He reframed the challenge from learning new tech (a burden) to reclaiming our expertise and becoming mentors for the digital age. This discursive work was essential in converting potential resistance into reluctant, then engaged, participation (Vice Principal for Curriculum, personal interview and observation, January 2025).

The peer-led demonstration strategy was a masterstroke in experiential sensemaking. More memos or speeches did not bridge the theoretical divide highlighted in interviews, but by creating tangible, low-risk proof-of-concept artifacts. The IoT-based monitoring project in the agriculture program served as a powerful boundary object. For skeptical teachers, it was a simple, manageable project. For leaders, it was a symbol of progress. For students, it was an engaging new tool. Its success in a school exhibition created a new, shared narrative: *"We can do this here."* This pilot served as a materialized vision, making the future tangible and reducing the perceived risk of change. It provided a concrete answer to the pervasive question, *"What does Industry 4.0 look like in our classroom?"* (Vice Principal for Curriculum, personal interview, January 2025).

An undercurrent in the sensemaking process was the leadership's use of strategic ambiguity. While providing clear strategic pillars, they deliberately avoided over-prescribing solutions for every department. As Mr. Yoga noted in an interview, *"We gave the direction 'towards Industry 4.0'—but each Kaprog had to find their own path based on their strengths and partner access."* This allowed for contextual adaptation and fostered a sense of ownership. However, it also required selective focus. Leadership resources (attention, rhetorical support, modest seed funding) were directed to the most promising pilots (such as the IoT project) that could deliver early wins and become exemplars. This created a de facto, but uncontested, priority list within the broader strategic vision (Vice Principal for Curriculum, personal interview, January 2025).

The strategic sensemaking at SMK Guna Dharma Nusantara was far more than just understanding an external trend. It was a socially negotiated, politically nuanced, and materially grounded process of threat diagnosis, multi-level translation, and meaning construction.

Leadership succeeded not by imposing a ready-made vision, but by expertly curating a process where the abstract "Industry 4.0" was collectively broken down, argued over, experimented with, and ultimately reconstructed as a concrete, context-specific school vision, a vision that was as much about preserving institutional relevance and teacher pride as it was about adopting new technologies. This process exemplifies dynamic capabilities in a resource-poor setting, where the primary strategic resource mobilized was not capital, but the collective cognitive and social capacity to make sense of a disruptive future.

Table 1: Strategic Sensemaking Process at SMK Guna Dharma

Level of Sensemaking	Key Activities & Mechanisms	Outcomes & Impacts
Leadership Level	○ Translating Industry 4.0 into strategic pillars (Digital Infrastructure, Future Skills, Deep Industry Collaboration) ○ Using opportunity & survival frames to motivate teachers ○ Strategic ambiguity to allow contextual adaptation	○ Concrete strategic vision ○ Increased teacher engagement and ownership ○ Reduced resistance to change
Middle Leader (Kaprog) Level	○ Translating strategic pillars into program-specific roadmaps ○ Breaking down industry feedback into actionable plans ○ Acting as a bridge between leadership and teachers	○ Operational clarity ○ Curriculum alignment with industry needs ○ Enhanced departmental autonomy
Teacher Level	○ Peer-led demonstration (e.g., IoT project in agriculture) ○ Participation in collaborative forums (Guru Belajar) ○ Translating operational plans into lesson activities	○ Tangible proof-of-concept projects ○ Increased digital competency ○ Pedagogical innovation in classrooms

Table 1 illustrates the multi-level and collaborative process of strategic sensemaking at SMK Guna Dharma, which cascades from the leadership level down to the teachers. At the top, school leaders translate the abstract concept of Industry 4.0 into concrete strategic pillars, using motivational frames of opportunity and survival to build commitment while employing strategic ambiguity to allow for contextual adaptation at lower levels. Middle leaders (*Kaprog*) then act as strategic translators, breaking down these pillars into program-specific roadmaps and bridging the gap between leadership vision and teacher reality, thereby achieving operational clarity and enhanced departmental autonomy. Finally, at the frontline, teachers bring these operational plans to life through peer-led demonstrations and collaborative forums like *Guru Belajar*, translating them into innovative lesson activities that produce tangible proof-of-concept projects and increased digital competencies in the classroom.

Orchestrating Alignment: The Micro-Politics of Curriculum and Partnership Reform

The implementation of strategic intentions revealed that curriculum alignment for Industry 4.0 was a deeply socio-political process, far more complicated than simply rewriting syllabi. The first major challenge was negotiating curricular space. The national curriculum (*Kurikulum Merdeka*) provided a framework but limited flexibility. Observations of curriculum committee meetings revealed intense negotiations among department heads over which traditional topics could be condensed or removed to make room for new content such as data analytics or additive manufacturing basics. The vice-principal for curriculum acted as a mediator, emphasizing the need for evolution, not revolution, to maintain buy-in (Vice Principal for Curriculum, personal interview, January 2025).

This internal negotiation was mirrored externally in the dynamics of partnership reform. The study, supported by observational data, found a strategic shift in the school's approach. While Memoranda of Understanding (MoUs) and internship collaborations were established, the partnership model observed during a teacher discussion session involved industry practitioners

who were simultaneously teachers at the school. This dual role facilitated a more integrated, though informal, knowledge transfer. Furthermore, interview data indicate negotiations for deeper involvement, such as scheduling industry-led socialization sessions or teacher training, moving beyond mere equipment provision (Field notes, observation of department head meeting, January 12, 2025).

The micro-politics of this alignment were most visible in the role of middle leaders (department heads or *Kaprog*). They became essential boundary spanners (Engeström, 2001). For instance, their practical responsibility included 'finding student placements for internships,' which positioned them as key connectors. This granular, trust-based work at the operational level was what made the high-level 'link and match' policy a reality. The findings in this section underscore that strategic leadership involves facilitating the complex negotiation work required for socio-technical alignment, often manifested in the coordinating and bridging duties of the *Kaprog* (Field notes, observation of department head meeting, January 12, 2025).

The negotiation over curricular space was not a neutral technical exercise but a political arena where subject identity and teacher status were at stake. The demand to condense traditional topics was perceived by some veteran teachers, particularly in foundational subjects like basic machining or network cabling, as a devaluation of their core expertise. As one senior machining instructor lamented in a focus group, "*They call it 'legacy content,' but it is the foundation. Without it, how will they appreciate the automation?*" The leadership, through the vice-principal for curriculum, had to manage this not by fiat but by orchestrating a trade-off narrative. They framed the change not as removing but as streamlining fundamentals to make space for advanced applications, thereby positioning the new content as the logical and prestigious culmination of the old. This required allowing departments a degree of autonomy in *what* to streamline, empowering *Kaprog* to negotiate internally with their own teams, which diffused centralized blame and localized the political friction (Head of TKJ Department, personal interview, January 2025).

The shift from charitable receipt to negotiated co-creation with PT Mitra Inovasi Teknologi represents a fundamental re-architecting of the school-industry interface. Analysis of the formal proposal and follow-up interviews reveals this was a carefully designed strategic exchange framework built on mutual, albeit different, needs: (1) School's Offered Value (Beyond Students): The proposal highlighted assets the industry undervalues: *secure physical space* for training, *administrative support* in managing sessions, and access to a *long-term talent pipeline*. This reframed the school from a passive beneficiary to an active service provider. (2) Industry's Reciprocal Value (Beyond Equipment): In return, the school negotiated for *intangible but critical resources*: contemporary expert knowledge (engineers as co-teachers), authentic assessment criteria, and teacher externships that updated pedagogical content at its source (Vice Principal for Curriculum, personal interview, January 2025).

This move required the school's leadership to think like a business, identifying and packaging its non-financial assets. The Teaching Factory Lite model was a boundary object that held different but compatible meanings: for the school, it was a cutting-edge learning lab; for the company, it was a cost-effective, extended training facility. The micro-political skill lay in proposing this model *before* the company could offer a simpler, less engaged donation, thereby steering the relationship onto more transformative ground from the outset.

The critical role of the department head (*Kaprog*) as a boundary spanner involved high-stakes translational and diplomatic labor that often went unrecognized within formal structures. Mrs. Nindianty's countless hours breaking down cloud-native development involved: (1) Jargon Translation: Converting industry terms (microservices, CI/CD pipelines) into core concepts (building small, connectable program modules, automated testing, and updates). (2) Pedagogical Sequencing: Determining what foundational programming concepts were absolute prerequisites before these advanced topics could be introduced, often having to advocate to industry partners

for a more scaffolded approach. (3) Expectation Management: Mediating between the industry's desire for job-ready specialists and the educational reality of teaching teenagers with varied aptitudes. This often meant negotiating which aspects of a complex skill were essential versus aspirational for the curriculum (Head of TKJ Department, personal interview, January 2025). This labor was not merely technical but deeply relational. Success depended on the *Kaprog's* ability to build *personal trust* with industry counterparts, often through informal interactions that then served as the grease for formal institutional agreements. Their authority in these external negotiations was paradoxically rooted in their internal credibility with teachers; they could make promises to industry because they understood what was pedagogically feasible.

Even in the improved model, a power asymmetry persisted. The company held the keys to current technology and market-validated knowledge. Observations revealed that school staff sometimes acquiesced to industry suggestions against their better pedagogical judgment, fearing the loss of the partnership. The leadership's role in this micro-political dynamic was to provide institutional backing for the *Kaprog* and teachers. For example, when an industry partner insisted on proprietary software that the school could not afford licenses for after graduation, the principal supported *Kaprog* in advocating for an open-source alternative, framing it as a matter of equitable student access. This institutional support was crucial in preventing co-creation from slipping into co-optation, ensuring alignment served educational principles alongside industry needs (Head of Pharmacy Department, personal interview, January 2025).

The process of alignment was sustained through deliberate rituals and artifacts. Quarterly partnership review meetings were not just administrative; they served as rituals of recommitment, where successes were celebrated, and grievances were aired in a structured setting. The MoU (Memorandum of Understanding), often seen as a mere formality, was used as a strategic artifact. The leadership ensured it contained specific, measurable commitments (e.g., 48 hours of engineer co-teaching per semester, one teacher externship annually) rather than vague promises. This textual specificity created accountability and gave the school a document to leverage if industry participation waned. These rituals and artifacts provided the formal scaffolding that enabled the informal, trust-based work of the *Kaprog* to be sustainable and scalable beyond individual relationships.

Orchestrating alignment at SMK Guna Dharma Nusantara proved to be a continuous, multi-arena political process. It involved internal negotiations over professional identity and curricular turf, external negotiations to reconfigure power and value in partnerships, and the indispensable, often invisible, diplomatic labor of middle leaders who spanned these worlds. Strategic leadership here was less about dictating the final aligned curriculum and more about designing and maintaining the forums, frameworks, and support systems within which these necessary negotiations could occur productively. It was about replacing a model of imposition with one of facilitated exchange—exchange of knowledge, resources, and legitimacy—between the school and its ecosystem, with the *Kaprog* as the essential brokers of this exchange. This complex orchestration turned the policy mantra of link and match into a lived, albeit constantly negotiated, reality (Vice Principal for Curriculum, personal interview, January 2025).

Table 2: Orchestrating Alignment: Curriculum & Partnership Dynamics

Aspect of Alignment	Challenges Encountered	Strategies Employed	Key Actors & Roles
Internal Curriculum Negotiation	- Generational divide among teachers - Resistance to reducing “legacy” content - Limited curricular flexibility	- Peer-led demonstration projects - Streamlining vs. removing content narrative - Departmental autonomy in implementation	- Vice Principal for Curriculum (mediator) - Kaprog (internal negotiator) - Champion Teachers (change agents)

External Partnership Development	- o Superficial MoUs - o Power asymmetry with the industry - o Limited industry engagement in teacher development	- o Negotiated co-creation model (e.g., PT Mitra Teknologi) - o Service exchange framework (facilities, admin support) - o Regular partnership review meetings	- o Principal & Vice Principals (strategic negotiators) - o Kaprog (boundary spanners) - o Industry practitioners (co-teachers)
Middle Leader as Boundary Spanner	- o Translating industry jargon into teachable content - o Managing expectations between school and industry - o Ensuring pedagogical feasibility	- o Personal trust-building with industry partners - o Advocacy for open-source alternatives - o Mediating between industry demands and educational reality	o Kaprog (translator, diplomat, operational link)

Table 2 delineates the complex process of orchestrating alignment at SMK Guna Dharma, which involves navigating both internal curriculum negotiations and external partnership dynamics through the pivotal role of middle leaders. Internally, leaders address challenges such as the generational divide among teachers and resistance to reducing "legacy" content by employing peer-led demonstration projects and framing curriculum change as streamlining rather than removal, all while granting departments autonomy in implementation. Externally, the school moves beyond superficial MoUs by adopting a negotiated co-creation model with industry partners, exchanging facilities and administrative support for deeper engagement in teacher development, with regular review meetings ensuring accountability. Crucially, the *Kaprog* (department heads) serve as indispensable boundary spanners who translate industry jargon into teachable content, manage expectations between both sides, and advocate for pedagogical feasibility, relying on personal trust-building and mediation to transform the "link and match" policy from a slogan into a lived reality.

Resourceful Leadership: Improvisation and Leverage in a Constrained Ecosystem

A dominant theme throughout the data was the acute awareness of and strategic response to profound resource constraints. The school's operational budget (*BOS*) was described as sufficient only for routine maintenance, not for transformative technology investments. In the face of this, the leadership demonstrated high levels of strategic improvisation and resource orchestration (Sirmon et al., 2011). One key strategy was asset repurposing and incremental upgrading. Rather than waiting for funding to build a new Smart Lab, the Electronics department, led by its *Kaprog*, systematically retrofitted old trainer kits with Arduino microcontrollers and sensors over three years. We started with one station, proved its learning value, and used that success to justify the budget for the next five, the *Kaprog* explained. This approach of building the plane while flying it enabled continuous development without large upfront capital (Head of TKJ Department, personal interview, January 2025).

The most significant resource orchestration, however, involved leveraging social and symbolic capital. The leadership actively cultivated the school's reputation. This reputational capital was then converted into tangible resources. Interview data provides concrete examples: student achievements were publicized through social media, PPDB brochures, and presentations at junior high school 'edufairs' or student work exhibitions to attract attention from the community and potential industry partners. Furthermore, a form of service exchange or 'barter' was observed, where some partner companies provided stipends or bonuses to internship students, with some students even offered continued work contracts post-internship. This created a virtuous cycle where symbolic and relational success led to material and motivational gains (Vice Principal for Students' Affairs, personal interview, January 2025).

This resourceful approach also extended to human capital development. Lacking funds for extensive external training, the school relied on internal collaborative learning. As confirmed in

interviews, an informal 'Guru Belajar' (Teacher Learning) community was nurtured, where teachers cooperated, exchanged thoughts, and built closeness akin to family.' This peer-led approach effectively built in-house professional development capacity at minimal cost, strengthening the internal social fabric and making the organization more resilient. This finding highlights how strategic leadership in a constrained environment is characterized by flexibility, creativity, and the continuous conversion of one form of capital (social, reputational, human) into another (Vice Principal for Curriculum, personal interview, January 2025).

The incremental upgrading of assets was not random improvisation but a deliberate philosophy of organic, evidence-based growth. The leadership consciously rejected the big bang project model, knowing it was unaffordable and risky. Instead, they championed a prototype-and-scale methodology. The single retrofitted Arduino station served as a functional prototype and, more importantly, a *rhetorical and political tool*. Its tangible success in student projects provided irrefutable evidence to present in budget meetings: This is not a wish-list item; this is a proven, working model that needs to be replicated. This turned a capital expenditure request into a logical expansion of a successful pilot, a far more persuasive proposition. This approach required patience and a tolerance for a patchwork infrastructure. However, it ensured that every rupiah spent was validated by prior pedagogical success, minimizing waste and building a narrative of continuous, measurable progress (Vice Principal for Curriculum, personal interview, January 2025).

The leveraging of social and symbolic capital operated within a sophisticated economy of dignity, where the school traded not on pity but on proven performance and potential. The grant from the multinational company's CSR fund was not charity; it was a reputational investment. The school's serious and innovative partner reputation was an asset the company wanted to associate with. By accepting the grant, the school entered a tacit agreement to maintain that reputation, further deepening the partnership. Similarly, the use of competitive symbolism was a form of strategic signaling. Winning the robotics competition sent multiple signals: to the district office (this school is a high-performer worthy of attention), to parents (this school offers cutting-edge opportunities), and to other industries (this school cultivates top talent). Leadership meticulously curated the dissemination of this news, ensuring photos with officials and partner logos were prominent, thereby directly linking the symbolic victory to the ecosystem that supported (or could support) it (Head of TKJ Department, personal interview, January 2025).

The *Guru Belajar* community represents a guerrilla approach to professional development in a resource-scarce environment. Its genius lay in its low-cost, high-engagement design: (1) It leveraged intrinsic motivation: It tapped into champion teachers' desire for recognition and informal leadership, and other teachers' need for practical, just-in-time learning. (2) It created a viral knowledge-transfer model: The train-the-trainer structure created multiplicative capacity. One trained champion teacher could upskill an entire department, bypassing the bottleneck and the high cost of external consultants. (3) It fostered social capital and collective efficacy: The community became a forum for solving practical problems, reducing teacher isolation, and building a shared identity as learners and innovators. This strengthened the organization's internal social fabric, making it more resilient and adaptive. This community was not a formal, top-down program but an orchestrated, informal network. Leadership provided the initial spark (identifying champions, legitimizing the time spent), the minimal structure (a regular meeting slot), and public recognition, then allowed it to grow organically based on real teacher needs (Vice Principal for Curriculum, personal interview, January 2025).

Resourcefulness also entailed skillful political navigation within the public bureaucracy. The leadership learned to play the long game with the district education office (*Dinas Pendidikan*). Instead of submitting a large, stand-alone proposal for an Industry 4.0 lab—likely to be rejected—they learned to embed their requests within approved priority frameworks. For instance, they framed sensor purchases for the IoT project under the "STEM Education Development" line item in the district's own plan. This required understanding bureaucratic priorities and reframing their

needs in the state's language, a form of translational political work. Furthermore, they engaged the school committee (*Komite Sekolah*) and the local community not just for donations but also as advocates who could lobby local government on the school's behalf, effectively mobilizing community social capital as political pressure (School Principal, personal interview, January 2025).

Beneath the formal budget existed a vibrant shadow economy of barter and in-kind exchange. Observations and informal conversations revealed transactions such as the school's multimedia students producing a promotional video for a local workshop in exchange for the workshop owner providing guest lectures and material donations to the engineering department. The leadership tacitly endorsed these decentralized, department-level barter arrangements, recognizing they generated immense value without cash flow. This required a culture of trust and entrepreneurialism among staff, which the leadership fostered by celebrating such stories as examples of "creative partnership" (Field notes, observation of department head meeting, January 12, 2025).

Resourceful leadership at SMK Guna Dharma Nusantara transcended mere frugality or clever improvisation. It constituted a sophisticated form of capital alchemy and ecosystem engineering. Leaders acted as *brokers* and *translators*, constantly moving value across different currencies: converting pedagogical success into budgetary claims, student competition wins into reputational credit, and teacher expertise into institutional professional development capacity. They mastered the politics of formal and informal systems, embedding their needs within bureaucratic frameworks while nurturing a shadow economy of mutual exchange. This approach recognized that in a constrained ecosystem, the most critical resources are often *relational, reputational, and intellectual* rather than purely financial. The strategic acumen lay in seeing these intangible assets as a form of capital that could be cultivated, strategically spent, and converted into the tangible tools and training needed for transformation. This deep orchestration of an entire resource ecosystem, not just a budget, was what enabled a school with severe financial limitations to undertake a credible journey toward Industry 4.0 readiness (School Principal, personal interview, January 2025).

Table 3: Resourceful Leadership: Capital Alchemy in a Constrained Ecosystem

Type of Capital	How It Was Cultivated	How It Was Converted/Leveraged	Outcomes
Human Capital	- Internal "Guru Belajar" community - Champion teacher model - Peer-to-peer training	- Self-sustaining professional development - Multiplicative knowledge transfer - Increased teacher collective efficacy	- Low-cost upskilling - Stronger internal collaboration - Adaptive organizational culture
Social & Relational Capital	- Trust-based partnerships with industry - Community engagement (school committee, local advocacy) - Shadow economy of barter exchanges	- Internship placements - In-kind donations & guest lectures - Political support from local stakeholders	- Enhanced industry collaboration - Access to non-financial resources - Increased community ownership
Symbolic & Reputational Capital	- Publicizing student achievements (competitions, exhibitions) - Strategic use of media and edufairs - Showcasing pilot projects as success stories	- Attracting better students (PPDB) - Securing CSR grants & industry funding - Gaining district-level recognition	- Improved school image - Increased enrollment interest - Additional funding opportunities
Financial & Material Capital	- Incremental upgrading (e.g., retrofitting old kits with Arduino) - Embedding requests in district priority frameworks	- Proof-of-concept to justify budget expansion - Strategic alignment with bureaucratic priorities - Sustained partnership deliverables	- Gradual infrastructure improvement - Sustainable resource acquisition - Reduced

○ Leveraging MoUs for tangible commitments	dependency on external
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Table 3 vividly captures the essence of resourceful leadership at SMK Guna Dharma as "capital alchemy," in which leaders strategically cultivate and convert various non-financial assets to compensate for severe material constraints. Human capital is developed through low-cost, peer-driven initiatives such as the Guru Belajar community, which foster self-sustaining professional development and a collaborative culture. This internal strength is complemented by the meticulous cultivation of social and relational capital through trust-based industry partnerships and informal barter exchanges, which are then leveraged to secure critical resources such as internships, guest lectures, and political advocacy. Simultaneously, the school strategically generates symbolic and reputational capital by publicizing student achievements and pilot project successes, converting this enhanced image into tangible gains such as increased enrollment and coveted CSR funding. Ultimately, this continuous cycle of cultivating and converting intangible assets—human, social, and symbolic—enables the incremental acquisition of financial and material capital, supports sustainable infrastructure improvements, and reduces the school's dependency on unpredictable external funding.

Discussion

The findings from SMK Nusantara Dharma suggest a model of strategic leadership for Industry 4.0 adaptation in resource-constrained VET contexts characterized by contextualized sensemaking, negotiated socio-technical alignment, and entrepreneurial resource orchestration. This discussion interprets these findings, using moderate academic language (hedging) and explicitly comparing them with prior empirical studies.

This study suggests that strategic sensemaking under significant constraints (Weick & Weick, 1995) is deeply relational and practice-embedded, a finding that extends, rather than merely confirms, existing theory. While prior studies (e.g., Gioia et al., 2012) emphasize visionary rhetoric as a sensemaking tool, this study reveals the critical role of material artifacts—low-cost, successful pilot projects (e.g., the Arduino-based IoT project) as 'boundary objects' (Leigh Star, 2010) that make an abstract future negotiable for skeptical staff. This provides a possible model for how leaders in similar contexts can build shared narratives of possibility through small-scale, demonstrable proofs of concept. This finding contrasts with studies in well-resourced schools (e.g., Harris & Jones, 2020), where sensemaking may rely more on external expert consultation than internal peer demonstration.

The findings challenge simplistic, compliance-based views of VET-industry alignment (Callan & Ashworth, 2004; Tyler & Dymock, 2021). At SMK Nusantara Dharma, leadership moved beyond transactional MoUs toward negotiated co-creation, a shift that indicates a more strategic use of institutional assets. This aligns with the concept of strategic resource orchestration (McGrath, 2012), but applies it to intangible assets such as institutional space and managerial capacity. Unlike prior research documenting dependence on industry charity in Indonesian VET (Arthur et al., 2023; Darmawan et al., 2023; Helmy, 2015; Triyono & Mateeke Moses, 2019; Wiriadidjaja et al., 2019), this study found leaders actively reframed the school as a service-providing partner. However, the persistence of power asymmetry, where staff sometimes acquiesced to industry demands against pedagogical judgment, suggests that full co-creation remains an evolving goal, echoing concerns raised by researchers in the studies of Vietnamese VET partnerships (Auplish et al., 2024; Nuttavuthisit, 2017; Reich & Ho, 2017; Seddon et al., 2020).

The most distinctive contribution of this study lies in its exposition of resourceful leadership as 'capital alchemy'. This conceptualization offers a potential alternative to deficit-based models of school resourcing. While prior resource orchestration literature (Andersén, 2023; Baert et al., 2016; Carnes et al., 2017; Hughes et al., 2018; McGrath, 2012) focuses on how firms manage existing

resources for competitive advantage, this study reveals how public school leaders cultivate and convert entirely different forms of capital—social (trust-based barter), symbolic (student competition wins), and human (teacher expertise)—when financial capital is absent. This finding resonates with the work of Prahalad (2012) on 'bottom of the pyramid' innovation, but, to our knowledge, has not been empirically detailed in VET leadership research. The leadership's role as an 'ecosystem engineer'—designing forums, networks, and exchange mechanisms (such as the Guru Belajar network or the shadow barter system)—represents a novel empirical insight that warrants further investigation.

A critical finding is the indispensable strategic role of middle leaders. This study confirms distributive leadership theories (Tony Bush, 2024; T. Bush, 2013, 2020, 2023b, 2023a, 2025) but adds a crucial nuance: distribution is not just an ethical choice but a strategic necessity, because the core work of linking school to industry occurs at this middle interface. This supports findings from Engeström's (2001, 2017) expansive learning theory on 'boundary spanners', but extends them by detailing the specific, high-stakes translational and diplomatic labor required in a VET context (e.g., jargon translation, expectation management). This suggests that leadership development programs must move beyond training principals to explicitly building the relational and brokering competencies of middle leaders.

Theoretically, this study integrates and advances several strands of literature. It provides a grounded model of how strategic leadership (Boal & Hooijberg, 2000; B. J. Davies & Davies, 2004), dynamic capabilities (Prieto & Easterby-Smith, 2006; Teece et al., 1997), and resource orchestration (Baert et al., 2016; Sirmon et al., 2011) theory manifest in a public educational setting in the Global South. It proposes that strategic leadership under constraint is an exercise in ecosystemic capital management, requiring skills in translation, negotiation, brokerage, and symbolic entrepreneurship alongside traditional strategic planning (Harima & Harima, 2025; Miles & Morrison, 2020; Zahra & Nambisan, 2012). Practically, the findings offer several lessons: For policymakers, Supporting VET transformation requires more than curriculum documents and equipment funds. It necessitates building the *strategic capacity* of school leaders, their ability to sense, negotiate, and orchestrate, and creating flexible policy frameworks that allow for local negotiation and partnership innovation. For school leaders, The journey begins with contextual sensemaking and building coalitions through small wins. Developing an entrepreneurial mindset to identify and leverage all forms of capital (social, reputational, human) is as critical as managing the financial budget. Empowering and supporting middle leaders is a non-negotiable strategic investment. For teacher educators and leadership programs, Curriculum must move beyond generic leadership styles to include competencies in stakeholder negotiation, partnership brokering, resource ecosystem mapping, and the political navigation of bureaucratic systems.

This study is a qualitative, in-depth case of one school. While it provides rich, contextual insights, its findings are not statistically generalizable. The school's location in a major industrial corridor may have provided more partnership opportunities than schools in remote areas. Future research could employ comparative case studies across different geographic and socio-economic contexts to test and refine the model of resourceful leadership presented here. Longitudinal studies tracking the sustainability of such adapted strategies over time would also be valuable. Furthermore, investigating the specific competencies and support systems needed by middle leaders (*Kaprodi*) who perform critical boundary-spanning roles would be a fruitful avenue for both research and professional development design.

CONCLUSION

This study demonstrates that strategic leadership for Industry 4.0 adaptation in resource-constrained vocational schools depends less on resource abundance than on leaders' capacity to mobilize and orchestrate relational, symbolic, and human capital. The findings identify three

interrelated leadership capabilities—contextual sensemaking, negotiated organizational alignment, and entrepreneurial resource orchestration—and introduce the concept of capital alchemy, which explains how intangible assets, including institutional reputation, teacher expertise, student achievement, and social legitimacy, can be strategically transformed into tangible resources through collaborative partnerships and value creation. By conceptualizing leadership as a relational capability for converting non-material assets into strategic organizational resources, this study extends strategic leadership theory beyond its predominantly resource-rich and Western foundations while offering a contextually grounded perspective from the Global South. In practice, the findings highlight the need for vocational education policies and leadership development programs to strengthen school leaders' competencies in stakeholder negotiation, partnership building, and resource orchestration, alongside investments in infrastructure and technology. Although the study is limited to a single instrumental case within an Indonesian public vocational school, it provides an analytically transferable framework for understanding leadership under resource constraints; future research should validate the proposed capital alchemy framework across diverse educational settings using comparative and mixed-methods approaches to further advance strategic leadership scholarship.

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