Teaching Factory Management in Improving the Quality of Graduates in Accordance with Industry Needs

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Abstract. This research is based on the high Open Unemployment Rate (TPT) of Vocational High School (SMK) graduates in Indonesia, which reached 8.00% in February 2025, although there has been a decline from the previous year. This phenomenon shows the misalignment between the competencies of vocational school graduates and the needs of the industry. Vocational schools as vocational education institutions are expected to produce graduates who are ready to work, both in terms of hard skills and soft skills, but in reality there are still many graduates who have not met industry standards. Therefore, an effective management approach is needed to improve the relevance and quality of graduates. The purpose of this study is to describe and analyze the management of Teaching Factory (TEFA) in improving the quality of graduates in accordance with the needs of the industry at SMK BPI Bandung. This research uses management theory from G.R. Terry which includes four management functions: planning, organizing, implementing, and evaluating. The research method used is a single case study to explore in depth the application of TEFA at SMK BPI Bandung. The results of the study show that the implementation of the four management functions of Terry in a holistic and synergistic manner has proven to be effective in improving the competence of graduates. Planning based on industry needs, collaborative organization, implementation through real job orders, and continuous evaluation have succeeded in creating graduates who are relevant to the demands of the world of work. The obstacles that arise are overcome through the addition of facilities, the improvement of teacher competence, and the strengthening of industry partnerships. The conclusion of this study is that the management of the Teaching Factory at SMK BPI Bandung has been effective and has succeeded in improving the quality of graduates. Strategic synergy with industry is the key to success, and emphasizes that a systematic and adaptive management approach is a fundamental prerequisite for the success of the TEFA program in the vocational education system.

Keywords: Teaching Factory Management, Graduate Quality, Vocational High School, Industry.

1   Introduction

Graduates of Vocational High Schools (SMKs) are expected to serve as the backbone of skilled labour in the Industry 4.0 era. However, the reality on the ground still shows a mismatch between graduates' competencies and workplace standards. This is indicated by the still high open unemployment rate among SMK graduates nationwide and findings that competencies are not yet fully aligned with industry needs, in both hard and soft skills. In this context, the Teaching Factory (TEFA) is positioned as a bridge that provides real production-based experience aligned with industrial standards within the school environment [1]. TEFA is a learning concept in a real-world setting aimed at bridging the competence gap between the knowledge delivered at school and industry requirements [2]. These facts represent an academic concern worthy of study, as the quality of TEFA management is believed to determine the effectiveness of production-based learning and, in turn, the quality and employment absorption of graduates [3].

Analytically, there is a gap that needs to be addressed. First, many reports highlight TEFA implementation at the pedagogical level and learning outcomes, but relatively few examine the entire managerial cycle of TEFA from planning and organizing, implementation based on real job orders, to evaluation and follow-up mechanisms tied to outcomes in terms of graduate quality and employment absorption [4]. Second, studies that place TEFA in the realm of information technology such as the development of applications, VR animation, and IoT systems are still limited, even though this sector is experiencing rapid technological leaps that demand managerial sensitivity to updates in facilities and infrastructure, curriculum, and up-skilling of teachers [5]. Third, empirical evidence linking TEFA governance with the latest policy ecosystem in the context of newly-running programs is still scant. These gaps call for a more comprehensive and contextual managerial study [6].

Previous literature provides an important foundation while also underscoring the need for this study. Research on school-industry partnerships emphasises curriculum link-and-match, on-the-job practice, and production-based learning as prerequisites for competency relevance with indicators such as employment waiting time, field-match, and graduate absorption rate [7]. On the other hand, studies on TEFA show its role as a learning arena that simulates industrial work procedures and culture, but the success of implementation is greatly influenced by the quality of planning, availability of facilities and infrastructure, and intensity of involvement of business and industry partners [8]. Several reports also highlight gaps in soft skills such as communication, discipline, and teamwork that are often not strongly formed in SMKs, so graduates require additional bridging when entering the workforce. A review of these prior findings indicates that managerial design – not just teaching method – becomes the key determinant for TEFA effectiveness[9].

Unlike studies that focus on learning achievement or mere practice description, this article offers novelty in at least four interrelated respects. TEFA is positioned as a comprehensive managerial unit of analysis, so the integration of planning, organising, implementation, and evaluation along with its causal relationship to graduate quality (output) and employment absorption (outcome) can be examined consistently [10]. The

study locus is on the newly-established TEFA program at SMK BPI Bandung, opening the opportunity to capture the dynamics of initial structuring, real-world field constraints, and emerging adaptation strategies. The sectoral focus is directed at information technology, including application development, virtual reality, and Internet of Things, which provides a managerial viability test in a technology domain with very rapid changes and still rarely explored in previous research. Data are constructed triangulatively from diverse stakeholders, namely the principal, vice-principal for curriculum, vice-principal for industry relations, head of the expertise program, productive teachers, industry partners, and students – thus producing a comprehensive picture that strengthens the validity of findings.

Conceptually, the novelty of this research lies in the formulation of a performance-oriented TEFA management model that links decisions on planning, organising, job-order-based implementation, and an evaluation mechanism comprising monitoring of product and service quality, industry feedback, and follow-up actions [11]. This model is positioned not as a mere literature review but as a literature-based argument that affirms why governance becomes the main lever, especially in the context of information technology that demands rapid renewal of devices, tool-chains, and teacher competencies. Thus, the article offers both conceptual and practical contributions in the form of a replicable framework and measurable managerial indicators[12].

Based on the foregoing description, this study aims to analyse the TEFA management practice at SMK BPI Bandung from upstream to downstream – namely planning, organising, implementation, and evaluation together with constraints and solutions – to map the role of business and industry in each node of managerial decision-making, and to assess its implications for graduate quality and employment absorption potential in the information technology sector [13]. The expected outcome is the formulation of operational managerial recommendations, including production scheduling design, coordination patterns with industry, teacher competency enhancement strategies, and authentic-assessment-based evaluation mechanisms that can be adopted by other vocational schools with similar characteristics, so that the TEFA ecosystem becomes relevant, adaptive, and sustainable.

2   Method

This study employs a qualitative approach with a case study method. It offers perspectives and an overview of Teaching Factory (TEFA) management aimed at improving the quality of graduates who can be absorbed into the industry. Through this research, detailed information or data can be obtained. The research was conducted in four stages: preparation, organization, implementation, and evaluation. Data collection techniques included interviews, documentation, and observation. Data analysis was carried out through the steps of data collection, data presentation, data reduction, and drawing conclusions. A qualitative approach is highly appropriate for studies focused on participants' interpretations of specific experiences or phenomena [14]–[18].

The research targeted key stakeholders, including the school principal, vice principal for curriculum, vice principal for industry relations, head of the expertise program, productive subject teachers, industry partner representatives, and eleventh- and twelfth-grade students involved in the Teaching Factory program. The population is understood as all actors directly involved from planning to evaluation of the program. Subject selection was done purposively based on information relevance and further developed through snowball sampling until data saturation was achieved [19].

Data collection techniques included semi-structured in-depth interviews, observation of workshop and production activities, and document analysis. Documents studied covered curriculum instruments, Teaching Factory organizational structure decisions, industry cooperation agreements, production schedules, quality control evidence, student product portfolios, quality meeting minutes, and graduate tracking data. Research instruments consisted of interview guides, observation checklists, and document review matrices. All data were recorded in field notes and audio recordings for transcription purposes [20]–[23].

The research procedure began with a pre-field stage, which included obtaining permits, refining instruments, and conducting a limited trial. The next stage was data collection through interviews, observation of Teaching Factory activities, and collection of supporting documents. Initial validation was carried out by confirming preliminary findings with key informants through member checking and enhancing credibility via source, technique, and time triangulation. The researcher then managed the data through transcription, identity anonymization, systematic archiving, and closing fieldwork with a compilation of findings for drafting the results [24].

This study applied the Interactive Model of data analysis by Miles, Huberman, and Saldana[21], which operates iteratively through four main components: data collection, data condensation, data display, and conclusion drawing. During data collection, the researcher gathered relevant information through in-depth interviews, participatory observation, and document review. Collected data were then condensed by selecting, focusing, simplifying, abstracting, and transforming interview transcripts, field notes, and school documents to align with the research focus on TEFA management for improving graduate quality [25]. The condensed results were presented in a structured description, possibly supplemented with diagrams, explanations of inter-category relationships, and narrative accounts to enhance traceability between findings and research questions. The analysis cycle concluded with drawing provisional conclusions, which were continuously verified by re-checking empirical evidence and theoretical grounding until a final conclusion was reached valid, consistent, and methodologically sound.

Validity was maintained through triangulation, member checking, peer debriefing, and audit trails. Ethical considerations included participant consent, confidentiality of identity, and the use of data solely for scientific purposes. This design is expected to yield a comprehensive understanding of Teaching Factory management at SMK BPI Bandung and its implications for enhancing graduate quality and employability.

3   Results

3.1   Teaching Factory Planning for Improving Graduate Quality

Planning is a fundamental component of management involving the setting of goals and the formulation of strategies to achieve them [26]. In the context of the Teaching Factory (TEFA) at SMK BPI Bandung, planning is carried out systematically through industrial needs analysis, curriculum development, infrastructure procurement, scheduling, and financial management. The study's findings indicate that industry needs analysis conducted via industry mapping, tracer studies, and focus group discussions (FGDs) with industry partners serves as the foundation for curriculum design that aligns with the labor market. The project-based curriculum and integration of real job orders ensure that students acquire both technical and non-technical competencies. Additionally, structured planning for facilities and production schedules allows learning to run efficiently without disrupting academic activities. Transparent and accountable financial management also supports the program's sustainability. These findings align with Terry's theory, which emphasizes that well-established planning is key to an organization's success in achieving its objectives[27].

From a regulatory perspective, this aligns with the Director General of Vocational Education Regulation No. 30 of 2025 concerning Technical Guidelines for the Development of TEFA Instruction, which outlines guidelines for planning, implementation, evaluation criteria, and accountability. The regulation provides a framework for TEFA implementation, emphasizing partnership planning with industries, student competency development, and the enhancement of practical learning quality to meet industry standards [28].

The industrial needs analysis phase is not conducted unilaterally but involves active collaboration with business and industry sectors. The school holds annual synchronization forums with industry partners to ensure that the curriculum remains updated with technological developments and industry trends. The analysis results are then compiled into a comprehensive report that serves as a reference for curriculum development, infrastructure planning, and teacher training programs. This process reflects that planning at SMK BPI Bandung is dynamic and responsive to external changes, consistent with the principles of strategic planning in Terry's management theory[29].

TEFA planning implementation also considers long-term sustainability. The school focuses not only on current needs but also on developing future-oriented development scenarios. This is reflected in annual budgeting for high-tech equipment procurement and continuous teacher competency development programs. Such an approach ensures that TEFA remains adaptive to technological advances and evolving industry demands, proving that comprehensive planning is an essential foundation for successful vocational programs [30], [31].

3.2 Academic Supervision Organization Based on Coaching

The organizing function in Terry's theory focuses on task assignment, authority, and coordination among members to achieve shared goals. At SMK BPI Bandung, TEFA organization is carried out by forming a clear organizational structure, task distribution based on competence, and coordination with industry. The principal serves as the policy director, teachers as facilitators, and students as active participants in industry simulations. Proportional and collaborative task distribution ensures that there is no overlap in authority. Coordination with industry through MoUs, curriculum synchronization forums, and practitioner involvement in learning strengthens TEFA implementation. These findings support Terry's assertion that effective organization fosters efficiency and synergy in program execution [32].

From a regulatory standpoint, this is aligned with Presidential Instruction No. 9 of 2016 on the Revitalization of Vocational High Schools, which mandates that TEFA organization must involve industry from the beginning, including in partnership structures, MoUs, and student practicum scheduling aligned with industry needs. The TEFA organizational structure is designed with principles of specialization and efficiency. Each unit has clearly defined job descriptions and well-defined lines of coordination. The head of the expertise program is responsible for technical execution, productive teachers guide students, and lab technicians manage equipment maintenance. This specific division of labor allows each member to focus on their area of expertise, enhancing operational efficiency and improving the quality of learning outcomes [33].

Organization also includes establishing effective coordination mechanisms with the industry. The school has formed an industry relations team that specifically handles partnerships with companies. This team maintains regular communication, coordinates industrial visits, and facilitates practitioner involvement in the learning process. Through this structured organization, the school has successfully built a learning ecosystem that is integrated with the professional world, enabling students to develop competencies truly relevant to industry demands [34].

3.3 Implementation of Academic Supervision Based on Coaching

The actuating function in Terry's management theory refers to the process of leading, motivating, and mobilizing organizational members to execute the established plans. At SMK BPI Bandung, TEFA implementation involves program socialization, production-based learning, industry involvement, and performance-based assessment. Socialization activities that involve all stakeholders teachers, students, parents, and industry partners help foster a shared commitment. Project-based learning activities, such as application development, VR animation, and IoT systems, provide students with real-world experience. Industry involvement as guest instructors and providers of real job orders ensures that the learning process aligns with industrial standards. Authentic assessments covering the learning process, final product, and work attitudes serve as instruments to verify students' competencies. These findings reflect Terry's

principle that effective implementation requires leadership, motivation, and the engagement of all parties.

From a regulatory standpoint, this aligns with Ministry of Education and Culture Regulation No. 34 of 2018 on National Standards for Vocational High Schools, which states that Project-Based Learning is the core of TEFA implementation. TEFA represents the operational execution of this learning standard. The actuating process is realized through a learning approach that simultaneously integrates theory and practice. Students do not merely learn concepts in the classroom they apply them directly in real-life projects commissioned by industry. In application development projects, for instance, students go through the complete software development cycle from needs analysis and system design to coding, testing, and implementation. This comprehensive experience provides a holistic understanding of the professional world while developing essential problem-solving skills [35].

Active industry involvement in the actuating process is a significant differentiator. Industry practitioners do not merely serve as guest lecturers; they are directly involved in guiding students through real-world projects. They offer direct feedback on students' work, share practical experiences, and introduce professional work standards. This direct interaction fosters contextual learning and encourages students to develop a strong work ethic and professionalism in line with industry expectations[36].

3.4 Evaluation of Academic Supervision Based on Coaching

In Terry's theory, the evaluation function aims to ensure that program implementation aligns with the plan and to make improvements when deviations are found. At SMK BPI Bandung, TEFA evaluation is carried out through product/service quality monitoring, learning process evaluation, industry feedback, and follow-up improvements. Quality monitoring for technology-based products (applications, VR animation, IoT) ensures that outputs meet industry standards. The learning process evaluation involves teachers, students, and industry to identify competency gaps. Feedback from industry is used to refine the curriculum and learning methods. Follow-up actions include curriculum revision, teacher training, and improvement of infrastructure, ensuring the program's sustainability. These findings support Terry's theory, which emphasizes that continuous evaluation is key to enhancing organizational quality[37].

From a regulatory perspective, this aligns with the Technical Guidelines for TEFA Instruction issued by the Directorate General of Vocational Education (Regulation No. 30 of 2025), which explicitly mandates mechanisms for monitoring, evaluation, and reporting of program implementation. The regulation requires schools receiving support to evaluate planning, implementation, and production outcomes to ensure alignment with industry standards. It also highlights the importance of ongoing evaluation to assess student competency achievement, the effectiveness of production-based learning, and the performance of industry partnerships. This evaluation extends beyond product outcomes to include work attitudes, technical skills, and social skills, ensuring that graduate quality remains relevant to labor market demands[38].

The evaluation mechanism is designed as a continuous cycle that includes both formative and summative assessments. Formative assessment is conducted during the learning process through direct observation, daily progress checks, and real-time industry feedback. Summative assessment focuses on evaluating final products and student competency achievement. This dual approach enables early problem detection and timely corrective interventions, minimizing the risk of failing to meet learning objectives[39].

The evaluation system also integrates digital technology to improve assessment accuracy and objectivity. The school developed a digital rubric accessible to teachers, students, and industry partners. This application supports transparent and consistent assessment processes while providing analytics to identify areas for improvement. The use of technology in evaluation not only enhances efficiency but also offers a robust data foundation for making continuous program improvements [40].

3.5 Challenges in Academic Supervision Based on Coaching

The main challenge found in TEFA implementation at SMK BPI Bandung is limited facilities and equipment. Inventory shows that some practice facilities do not yet meet industry standards, resulting in student learning experiences that fall short of real working conditions. In planning theory by G. R. Terry, the availability of infrastructure is a key factor in achieving set goals. If resources are inadequate, learning strategies become less effective, and the goal of improving graduate competency may not be fully realized [41].

Another challenge is human resource limitations. The number of productive teachers and lab technicians does not yet match the student population and the complexity of production projects. This creates a heavy workload and risks reducing supervision quality. According to management theory, organizing requires proper task distribution and appropriate personnel placement based on competencies. Gaps in human resources can cause inefficiencies in production processes and inconsistency in student output quality [42].

Additionally, the study identified curriculum misalignment with industry needs and the challenge of rapid technological change. An outdated curriculum leads to certain skills being no longer relevant to current workplace demands. In terms of implementation, this limits the effectiveness of learning because students are not trained according to the latest standards. Rapid technological advances also require schools to continuously update teaching materials and equipment, demanding an adaptive control mechanism. Content and process standards under Ministry Regulation No. 34 of 2018 mandate that vocational curricula be aligned with labor market needs and delivered interactively, inspirationally, and contextually. When the curriculum no longer reflects current industry developments, TEFA serves as a corrective and synchronization tool, as production-based learning demands curricular alignment with current technologies and procedures. Thus, TEFA also functions as a curriculum evaluation instrument to ensure link and match with industry needs[43].

3.6   Solutions for Academic Supervision Based on Coaching

To address facility limitations, the school has conducted comprehensive inventory, drafted a priority-based budget plan (RAB), and established partnerships with industry to receive equipment donations, borrow facilities, or provide students with hands-on practice in partner workshops. Within the planning framework, these actions represent rational resource allocation to ensure learning goals are still achievable despite limited resources. Ministry Regulation No. 34 of 2018 on Vocational National Education Standards requires vocational schools to have practice facilities such as workshops, labs, and equipment aligned with the competencies taught. Accordingly, TEFA must be equipped with industry-standard production tools to replicate real work environments. If school equipment is outdated or below specification, these standards are not met, and upgrades must be pursued through school budgets or government support programs like the Center of Excellence Vocational School initiative[44].

To overcome human resource limitations, school management maps teaching and technical staffing needs, recruits additional teachers, and provides training and certification to enhance existing competencies. Industry practitioners are also brought in as guest instructors to offer students real-world experience. This strategy reflects the organizing function, ensuring the right people are placed in the right roles and can perform according to standards. The educator standards under Ministry Regulation No. 34 of 2018 require vocational teachers to have appropriate academic qualifications and competencies in their field. In TEFA, teachers are not only theoretical instructors but also act as production supervisors, workshop managers, and student work ethic mentors. If human resources lack qualifications or technological upskilling, TEFA quality declines. Thus, the regulation encourages schools to implement continuous professional development for productive teachers and technicians.

To address curriculum misalignment and rapid technological changes, the school conducts curriculum synchronization forums with industry partners, regularly updates curriculum documents, and integrates project-based learning with real job orders. Teachers are offered upskilling opportunities through industry internships, while students are introduced to current technologies such as cloud-based application development, VR/AR, and IoT. This mechanism demonstrates both implementation and control functions, as learning is delivered according to the latest standards and continuously evaluated to remain relevant to industry needs (Arham, 2024).

4   Discussion

The findings of this study demonstrate that effective TEFA management at SMK BPI Bandung hinges on a structured, industry-aligned planning process. Through comprehensive industry needs assessments such as tracer studies, FGD sessions with industry partners, and annual synchronization forums—the school successfully crafts a curriculum that is both relevant and responsive to real-world demands. This alignment ensures that technical and non-technical competencies delivered in the classroom are in sync with the expectations of the labor market.

The implementation phase—executed through project-based learning and real job orders has been particularly effective in bridging the gap between theory and practice. Students are directly involved in the full production cycle of applications, VR content, and IoT systems. These hands-on projects simulate authentic workplace scenarios and enable learners to develop critical skills in communication, teamwork, problem-solving, and professionalism skills that are often cited as lacking among vocational graduates.

Industry involvement throughout the implementation stage serves as a distinctive strength of the TEFA model. Practitioners not only deliver guest lectures but also mentor students during live projects, providing valuable feedback, sharing up-to-date knowledge, and modeling industrial work standards. This ongoing interaction enriches the learning experience and motivates students to uphold work ethics aligned with industry culture, ultimately producing more job-ready graduates.

Continuous evaluation mechanisms embedded within TEFA reinforce the program's relevance and effectiveness. Both formative and summative assessments—backed by digital rubrics and analytics tools enable teachers, students, and industry partners to monitor progress and address gaps promptly. Moreover, the inclusion of industry feedback in curriculum and instruction revisions ensures that learning stays aligned with evolving technological and professional standards.

Despite its strengths, TEFA implementation at SMK BPI Bandung faces notable challenges. Infrastructure gaps and outdated equipment still hinder the full realization of industry-standard practices in some areas. Additionally, the school grapples with limited human resources, particularly in terms of the number of qualified productive teachers and lab technicians, resulting in heavier workloads and a risk of inconsistent supervision quality.

The school has responded to these limitations with strategic solutions, including partnerships with industry for equipment support, targeted budgeting, and professional development programs for teachers. Upskilling efforts through certifications and industry internships for educators, as well as curriculum revisions based on job order analysis, showcase the school's commitment to maintaining TEFA's relevance in the face of rapid technological change.

Overall, this study highlights that systematic and adaptive management is essential to the success of vocational education programs such as TEFA. The integration of planning, organizing, executing, and evaluating—driven by strong collaboration with industry serves not only to improve graduate quality but also to ensure long-term sustainability. These findings can inform policy and practice at other vocational institutions seeking to replicate or refine the TEFA model in different sectors and contexts.

5   Conclusion

Based on the research findings, it can be concluded that the management of the Teaching Factory (TEFA) at SMK BPI Bandung has been effectively implemented through stages of industry-driven planning, collaborative organizing, real job order

based execution, and continuous evaluation proven to enhance the relevance of graduates' competencies to labor market demands. Strategic synergy with business and industry has been a key factor in overcoming various challenges and producing graduates who are competent, competitive, and ready to contribute to the workforce. This study affirms that a systematic and adaptive management approach is a fundamental prerequisite for the success of TEFA programs within the vocational education system. Accordingly, the general research objective to examine and analyze the management of the Teaching Factory in enhancing graduate quality aligned with industry needs has been achieved.

It is recommended that future research expand from a single-case study to comparative analyses across multiple vocational schools and industrial sectors to capture the diversity of TEFA models and their determining factors. Moreover, combining qualitative approaches with quantitative methods is advised through the use of standardized performance metrics such as employment absorption rate, waiting period, initial wages, certifications obtained, portfolio quality, and soft skill indicators using a longitudinal tracer study design that tracks graduates for a minimum of 6 to 24 months. Researchers could also test the effectiveness of specific interventions such as real job order–based curricula, teacher internships, or industry-led quality control through quasi-experimental designs like difference-in-differences or propensity score matching, and analyze mediating and moderating variables using structural equation modeling. Cost–benefit and cost-effectiveness studies are essential to assess the sustainability of TEFA funding, while learning analytics utilizing system logs, digital rubrics, and project artifacts can be used to objectively measure competency development.

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