

Integrating Heritage Industries into Engineering Education: A Technical Review and Framework Design for a Shoe and Leathercraft Specialization under the BS Industrial Engineering (BSIE-SL) Program at Marikina Polytechnic College

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Date Submitted:
January 29, 2026

Date Accepted:
February 28, 2026

Date Published:
March 07, 2026

DOI:
10.5281/zenodo.18897361

ABSTRACT

This research paper presents a technical design review for the proposed program offering of a specialization in Shoe and Leathercraft within the Bachelor of Science in Industrial Engineering (BSIE) program at Marikina Polytechnic College (MPC). Situated in Marikina City, Philippines, the country's recognized footwear capital, MPC bears a unique responsibility to align its academic offerings with the city's enduring tradition of shoemaking and leathercraft. The institution, which already offers Bachelor of Science in Electronics Engineering (BSECE) and Bachelor of Science in Computer Engineering (BSCpE), is

strategically positioned to expand its engineering programs with a specialization that reflects both local identity and industrial relevance. This review focuses on the academic planning and design required for the program, without implementing it. Drawing from local and international models in niche manufacturing education, the study outlines essential components such as curriculum structure, skill-based outcomes, facility and equipment needs, faculty preparation, and industry-academe collaboration. Emphasis is placed on integrating digital fabrication, sustainability practices, and real-world experience through local partnerships. A phased approach, beginning with pilot electives is proposed to manage institutional readiness and student engagement. Findings suggest that the proposed specialization is timely, contextually relevant, and technically feasible. This initiative aligns with the Commission on Higher Education (CHED) standards and addresses the growing need for engineers equipped with both technical skills and cultural awareness. As the program remains in study, it is advised to prioritize curriculum piloting, invest in faculty upskilling, and establish strong industry partnerships. This review provides academic leaders and policymakers with a practical foundation for developing a future-ready program that supports local innovation while preserving Marikina's shoemaking legacy.

Keywords: *Industrial Engineering, Shoe and Leathercraft, Curriculum Design, Specialization, Footwear Industry*

INTRODUCTION

The footwear and leathercraft industry has been a part of Marikina City's cultural heritage and economic foundation. It is recognized as the "Shoe Capital of the Philippines," Marikina has built a national reputation for craftsmanship and local enterprise (UNIDO, 2023). Despite this legacy, the industry faces growing challenges including global competition, an aging labor force, and a lack of technological advancement (UNESCO-UNEVOC, 2023; OECD, 2019). To support the advancement, academic institutions must take proactive steps to ensure their programs align with the evolving needs of local industries (CHED, 2018; Lagerqvist, 2020). BS in Industrial Engineering (BSIE), as a discipline, is well-equipped to contribute to the transformation of traditional sectors through process improvement, production efficiency, ergonomics, and supply chain integration (Salvendy, 2012; Badiru, 2014). Integrating a specialization in Shoe and Leathercraft within the Bachelor of Science in Industrial Engineering (BSIE-SL) program applies these principles to address specific gaps in the local footwear industry while also preparing graduates with technical and sector-specific competencies. The need for specialized, skill-driven academic tracks has never been more urgent—especially those that reflect both the heritage and innovation potential of local economies (Ray & Srivastava, 2020; Evans & Clarke, 2018).

Marikina Polytechnic College (MPC), known for its strong foundation in technical and vocational education, is located at the heart of the country's shoemaking industry, Marikina City. With this unique advantage, the Institution is in a strong position to develop a program that supports and strengthens the local footwear and leathercraft sector. In the year 2020, MPC began offering a Bachelor of Science in Entrepreneurship with a specialization in Shoe and Leathercraft, which marks an early step in bridging academic learning with industry tradition and demands. Also, MPC can consider possibilities of introducing technical specialization within its Bachelor of Science in Industrial Engineering (BSIE) program specialized in Shoe and Leathercraft (BSIE-SL). This new possible specialization aims to combine engineering practices and principles with practical knowledge of the footwear trade in an engineering approach. It will support MPC's current engineering programs, like Electronics Engineering (BSECE) and Computer Engineering (BSCpE), which prove the institution's capability in offering quality engineering education. Also, the proposed BSIE-SL specialization reflects not only the industrial needs of the Marikina footwear sector but also supports the goals of Technical and Vocational Education and Training (TVET) and Gender and Development (GAD) by promoting inclusive, skill-based education that is accessible to all learners regardless of gender or socioeconomic background (Margherita & Braccini, 2021; Villani et al., 2017).

Alongside these programs, MPC also has two key resources that support this direction; the Shoe and Leathercraft Development Center (SLDC) and the Reinnovate Shoes and Other Leathercrafts for Entrepreneurship Startups (ReSOLES) Technology Business Incubator (TBI). Both focus on skills training, product development, and business incubation related to shoe and leathercraft, and they may serve as valuable support systems for the engineering track in the future. This paper presents a technical review to help guide the academic design process. It draws insights from policy, practice, and community needs, and outlines how MPC can take meaningful steps toward building a program that supports both local heritage and modern industrial progress (Calderón-Andrade et al., 2020; Braglia et al., 2022).

Objectives

The main objective of research study are: (1) to study if MPC is has the capability to offer a Shoe and Leathercraft specialization under the BS Industrial Engineering program in terms of faculty, facilities, and existing resources; (2) to look at examples from other countries and schools that successfully included traditional industries like shoemaking in their engineering programs; (3) to understand what skills and knowledge are needed by the local shoe and leathercraft industry in Marikina, so the program can match real-world needs; and (4) to create a clear plan and design for the program, including the specialized subjects to be offered, tools and equipment needed, and steps for gradual implementation.

METHODS

This study presents a narrative review methodology to explore the feasibility and guide the initial academic design of the proposed BS in Industrial Engineering with Specialization in Shoe and Leathercraft (BSIE-SL) at Marikina Polytechnic College (MPC). As the initiative remains in the proposal and design stage, the research focuses on developing conceptual frameworks that support MPC's mandate under RA 9289 and as a future-ready institution.

LITERATURE REVIEW

The review of related literature plays an important part in this study and initial design of the proposed BSIE-SL specialized program and it includes the following; peer-reviewed journals, conference proceedings, case studies, and a non-traditional material such as technical reports and institutional publications. It also focused on framework designs, reviewing outcome-based education (OBE), the addition of technical-vocational fundamentals, and review of viable practices in footwear and leathercraft manufacturing. In line with this, International literature review which includes educational innovations from the United Kingdom, Italy, and Southeast Asia, it was particularly instrumental in shaping the preliminary specialization framework (Braglia et al., 2022; Calderón-Andrade et al., 2020).

Policy and Curriculum Analysis

In line with MPC's mandate, the design of the specialization is expected to make a significant contribution to the institution's future direction and development. This study reviewed existing education policies and curriculum standards established by the CHED and the TESDA. Although the program remains in the design stage, it was necessary to examine these official guidelines to ensure that the proposed track aligns with national standards and maintains future competitiveness. The CHED Memorandum Order (CMO) No. 37, series of 2012, which outlines the expected outcomes and curriculum structure for BS in Industrial Engineering, was also examined. Scholarly sources provided insight into OBE curriculum structuring and evaluation methods (Japee & Oza, 2021; Spady, 1994). TESDA's Leatherworks NC II

Training Regulations were also reviewed to extract industry-validated competency profiles, practical credit requirements, and instructional best practices aligned with TVET frameworks. From these information, the study gathered reference points such as required learning outcomes, recommended credit hours, and key areas for competency-based instruction in the field. These data were not used to finalize any curriculum but will serve as to guide the ongoing design of the BSIE-SL specialization, ensuring that any future development stays consistent with national academic and industry expectations when implemented.

Contextual Review of Local Industry Needs

To ensure alignment with real-world conditions, the review evaluated secondary data sources related to the Marikina footwear industry. Local literature review from DTI, DOST-FPRDI, SMEs, and studies on heritage industries provided a basis for understanding current production challenges, skill shortages, and modernization gaps. Although no direct consultations have been conducted at this stage, the study considered insights from existing industry reports, published assessments, and local economic trends to identify potential engineering roles relevant to the leathercraft sector. These secondary sources provided initial guidance on how the program could be aligned with the practical needs of the Marikina footwear industry and support broader goals in industrial modernization and heritage preservation.

Institutional Readiness Review

This study reviewed available documents and existing program records at Marikina Polytechnic College (MPC) to assess the school's preparedness to support the proposed specialization in Shoe and Leathercraft under the BS Industrial Engineering program. One of the specialized program of MPC is its Bachelor of Science in Entrepreneurship with a specialization in Shoe and Leathercraft, which started in 2020. The existing program already links the school to the local footwear industry and also provides an academic base which can support BSIE-SL program. Also, MPC has already its implementation of the Shoe and Leathercraft Development Center (SLDC) and the ReSOLES Technology Business Incubator (TBI), both of which focus on innovation and entrepreneurship in the local leathercraft sector that supports MPC's mandate. Likewise, facilities offer important resources such as prototyping spaces, industry linkages and opportunities that could later support the implementation of practical engineering activities related to the program specialization. In line with this, the study considered relevant TESDA regulations and CHED outcomes-based models to ensure that the proposed program incorporates TVET-aligned competencies while promoting gender-responsive education in accordance with GAD principles.

Framework Design

The study proposes frameworks that integrates academic readiness, industry collaboration, and strategic curriculum development to guide and strengthen the design of the BSIE-SL program at Marikina Polytechnic College (MPC). The framework includes key components: (1) a technical framework to align institutional capacity with industry needs; (2) a collaborative structure linking MPC's academic units and innovation platforms such as the TBI and SLDC; (3) a strategic framework ensuring alignment with CHED

and TESDA standards; (4) curriculum review focused on specialized subjects in footwear, leathercraft, and sustainable manufacturing; (5) a phased academic integration plan for gradual program implementation; and (6) an overall research framework to monitor development and ensure relevance to both academic and industry stakeholders. As an evolving framework, it can be further refined through continuous stakeholder engagement, adherence to education policies, and strengthening of institutional capacities to support the successful implementation and long-term viability of the specialized program.

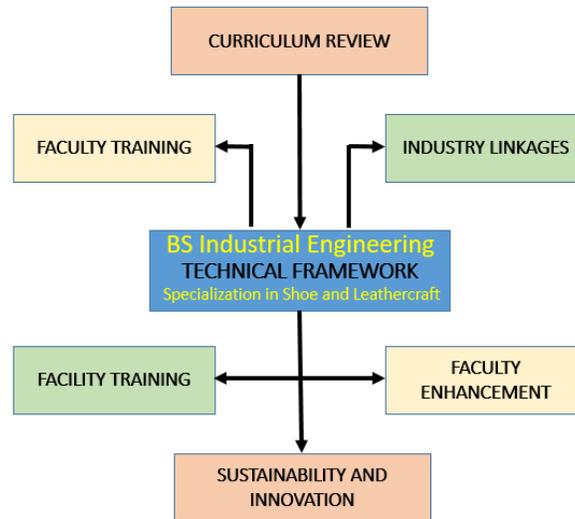


Figure 1. *Technical Framework Proposal for Academic Readiness and Industry Linkages in Implementing the Specialization in Shoe and Leathercraft*

Designing a Shoe and Leathercraft specialization within an engineering program combines industrial engineering principles, vocational competencies, and knowledge of heritage industries. The University of Northampton and the Glasgow School of Art in United Kingdom integrate shoemaking and leathercraft practices into design and engineering courses through close partnerships with local craft industries (Lambert, 2021). In Italy, schools such as Arsutoria School and Accademia Riace have long provided structured shoemaking education, blending traditional craftsmanship with modern manufacturing and working directly with small and medium-sized footwear companies (Arsutoria School, n.d.; Accademia Riace, n.d.).

In the Philippines, vocational programs remain an important part of sustaining traditional industries. TESDA offers Leatherworks NC II, which gives learners basic shoemaking and leathercraft skills. Building on these vocational foundations, the proposed Shoe and Leathercraft specialization under the BS Industrial Engineering program at Marikina Polytechnic College (MPC) would add engineering knowledge, digital design, and process automation. This approach follows CHED’s outcomes-based education model and supports MPC’s legal mandate under Republic Act No. 9289 (2004).

A heritage-linked academic programs do not only preserve cultural identity but also help innovation, entrepreneurship, and employability. UNESCO-UNEVOC (2023) notes that linking craft industries with education strengthens community resilience and supports economic growth. Altbach and Knight (2007) states that higher education programs are more effective when they balance global practices with local relevance. Bryson (2018) also highlights the need for careful academic planning, with stakeholder involvement, faculty training, facility upgrades, and industry partnerships to ensure sustainable implementation of programs. Through this framework and in timely manner, MPC can respond to local industry needs, modernize traditional practices, and provide a unique engineering specialization that connects heritage, technology, and community development. At the heart of the framework lies the BS Industrial Engineering Shoe and Leathercraft Technical Framework, designed to embed industry-driven competencies into the engineering curriculum. This core component is supported by six strategic pillars:

Curriculum Review

The foundation of the BSIE-SL specialization lies in reviewing a curriculum that meets the CHED Outcomes-Based Education (OBE) standards and aligns with existing BSIE program outcomes. It must offer a balance of theory and hands-on application, covering core areas such as leathercraft fundamentals, CAD modeling, sustainable product development, and engineering practice and principles applied to footwear manufacturing. This multidisciplinary approach helps students acquire both technical proficiency and creative problem-solving skills, in line with leading global practices in heritage-based engineering education (Ray & Srivastava, 2020). Below is the OBE-Framework of Institute of Engineering at Marikina Polytechnic College (MPC).

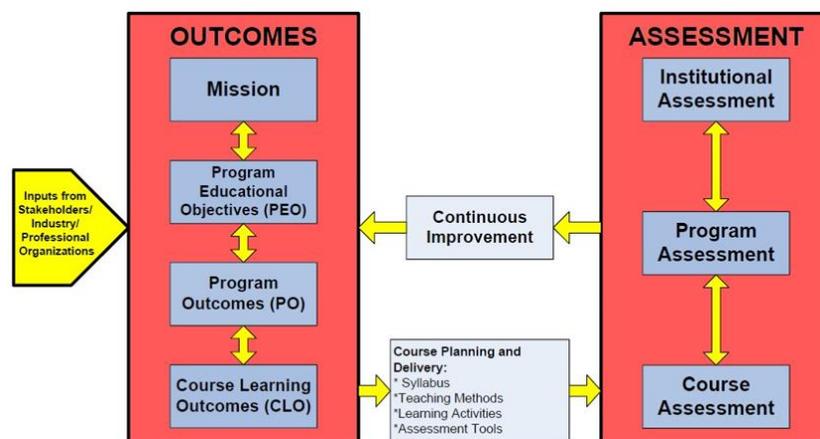


Figure 2. Outcomes-Based Education Framework of the Institute of Engineering, Marikina Polytechnic College (MPC), as the Basis for the Proposed BSIE-SL Program

The Outcome-Based Education (OBE) Framework of MPC College of Engineering ensures that

academic programs are aligned with industry needs through clearly defined outcomes, from institutional missions to course-level learning objectives. For the Bachelor of Science in Industrial Engineering with Specialization in Shoe and Leathercraft, this framework helps shape a curriculum that equips students with practical and technical skills in design, manufacturing, and sustainability. Inputs from stakeholders like shoe manufacturers and professional organizations ensure relevance, while course assessments and program evaluations support continuous improvement. This approach ensures that graduates are well-prepared to meet industry demands and contribute to innovation in the footwear and leathercraft sectors.

Industry Linkages

It is important to plan of the predesign of the BSIE-SL specialization with local footwear makers, especially those in Marikina. These linkages should encompass more than just internships. The industry must be involved in developing curricula, sharing of tools and production facilities, and use of students for hands-on learning. Students can learn more about current practices, techniques, and technologies being used in manufacturing operations and will be able to train according to the requirement of local footwear. Marikina Polytechnic College has existing programs and facilities to help with this approach. Shoe and Leathercraft Development Center (SLDC) is engaged with local shoemakers, cooperatives and designers for product development, small manufacturing and training based on actual market needs. Also, the ReSOLES Technology Business Incubator (TBI) serves as a platform for students and aspiring entrepreneurs able to develop innovative ideas, get mentored, and connect with local and international partners. To future-proof the program while making it relevant in current times, the efforts will streamline the incorporation of Industry 4.0 principles.

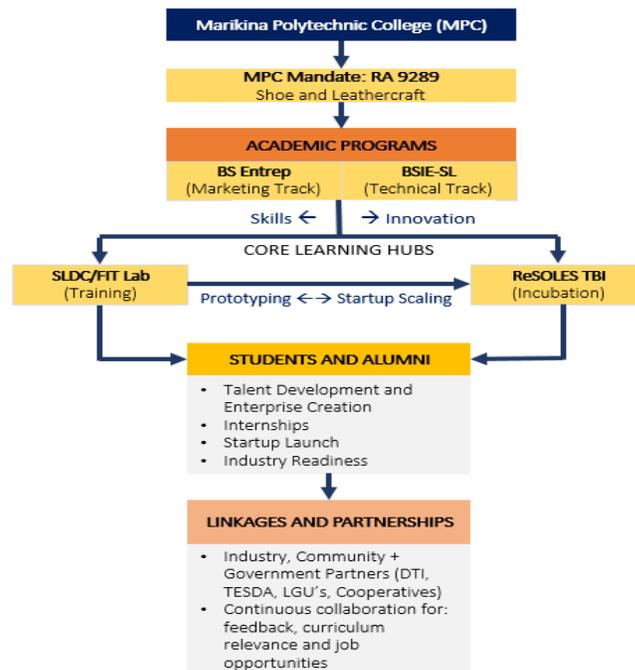


Figure 3. *Proposed Collaborative Framework of MPC's Academic and Innovation Platforms for the*

Footwear Sector

Marikina Polytechnic College (MPC) actively supports the revitalization of the shoe and leathercraft industry through its existing BS Entrepreneurship program, which provides students with essential marketing and business development skills tailored to Marikina's footwear sector. The proposed BS Industrial Engineering with a Specialization in Shoe and Leathercraft (BSIE-SL) is designed to complement this by integrating engineering-based competencies relevant to footwear manufacturing; such as materials processing, CAD/CAM design, and automation workflows. This synergy is strengthened by two key institutional innovation platforms: (1) the Shoe and Leathercraft Development Center (SLDC), which collaborates directly with local shoemakers, cooperatives, and designers in product development, prototyping, and small-scale production based on real market needs; and the (2) ReSOLES Technology Business Incubator (TBI), which mentor's student entrepreneurs and enables the transformation of product concepts into viable business ventures. These platforms function in tandem, where technical training supports innovation and entrepreneurial feedback refines the academic design approach. These initiatives are anchored in ongoing collaborations and capacity-building efforts. MPC's ReSOLES TBI has undertaken design-thinking workshops with partners like SCALE-NCR in collaboration with DOST-PCIEERD to refine programming and incubation protocols (Department of Science and Technology – NCR, 2024). The TBI's engagement extends internationally; in July 2025, the ReSOLES team joined in a visit to Taipei, strengthening ties with Taiwan's footwear industry and driving global industry-academe alignment. Also, MPC's TBI formalized a Memorandum of Understanding with Leave a Nest Philippines to reinforce support for innovation in leathercraft and footwear startups (Leave a Nest Philippines, 2025). MPC has also inaugurated a Footwear Innovation and Technology (FIT) Research Laboratory, a facility created through collaboration between SLDC and ReSOLES TBI to support research, prototyping, and technological advancement in footwear design. By positioning students and alumni at the heart of this ecosystem, MPC ensures that academic training, industry exposure, and innovation converge in a cycle that prepares graduates for employment or entrepreneurship. Partnerships with government agencies, local industries, and community stakeholders further ensure that curriculum and training remain relevant, sustainable, and aligned with Marikina's identity as the Philippines' Shoe Capital. It is timely since the structure reflects MPC's commitment in sustaining Marikina's legacy as the country's shoe capital.

Faculty Training

A successful specialization program depends heavily on the competency of faculty members. Instructors must be provided with access to training in lean production systems, materials engineering, and digital prototyping tools. Instructor capacity is central to program success. Faculty will participate in formal training on lean production systems, materials engineering, and digital prototyping tools, ensuring course delivery remains both up-to-date and contextually relevant. Empirical evidence underscores the value of such professional development for maintaining curriculum quality (Kalwar & Khan, 2023).

Facility Enhancement

To support practical learning, the program requires the enhancement of MPC's existing facilities.

This includes establishing labs equipped with CAD/CAM systems, cutting tables, stitching machines, and finishing equipment. Such infrastructure will replicate actual footwear production settings and provide students with meaningful, industry-relevant experiences (TESDA, 2022; DOST-FPRDI, 2020).

Facility Training

Alongside facility upgrades, appropriate training in equipment usage must be provided. Both students and faculty should undergo orientation and simulations covering machine operation, digital workflows, and safe manufacturing practices. These efforts should follow national standards such as TESDA's Leatherworks NC II guidelines and global best practices (TESDA, 2022).

Sustainability and Innovation

Vital to the proposed specialization is a focus on sustainable design and innovation. This includes the use of eco-friendly and recycled materials, ethical sourcing, and the integration of circular economy principles. This aligns with OECD recommendations on sustainable regional development and innovation in heritage industries (OECD, 2019; Salazar et al., 2022). By embedding these principles, BSIE-SL supports national SME development goals while positioning MPC as a leader in combining technical excellence with cultural preservation. By embedding these components within a cohesive framework, the proposed specialization in Shoe and Leathercraft not only supports national goals on SME development and regional industrialization but also reinforces the role of engineering education in preserving cultural industries. This initiative represents a forward-thinking model for combining technical excellence with heritage innovation positioning MPC as a pioneer in outcome-based, industry-integrated curriculum design.

FINDINGS, RESULTS, DISCUSSIONS

The review shows several successful models where engineering specializations are tailored to local industries to support economic development and improve graduate employability (Euler, 2013; Lee & Kim, 2018). In regions with niche manufacturing clusters, universities have designed specialization tracks integrating sector-specific tools, technologies, and case-based learning. Examples include Germany's dual-training system and South Korea's university-industry consortia, both of which demonstrate effective alignment between academia and industry (OECD, 2020). For MPC, the BSIE specialization in Shoe and Leathercraft is proposed to be structured around four thematic pillars: (1) the curriculum mapping, (2) technology and sustainability integration, (3) competency alignment, and (4) phased implementation strategy.

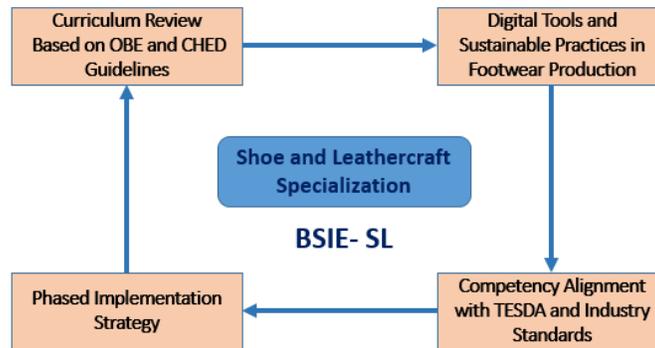


Figure 4. *Proposed Strategic Framework in Designing the Shoe and Leathercraft Specialization under the BSIE-SL Program*

This framework illustrates the proposed specialization, which is supported by four interrelated components like; first, curriculum mapping is guided by Outcomes-Based Education (OBE) principles and Commission on Higher Education (CHED) guidelines to ensure academic compliance and relevance. Second, is the integration of smart and automated tools and sustainable practices in footwear production which highlights the program’s emphasis on innovation and environmental responsibility. Third, the framework integrates competency alignment with TESDA and established industry standards which ensures that the specialization responds to the practical skill requirements of the local and national industry demands. And lastly, a phased implementation strategy is also proposed to gradually introduce the specialization which allows time for institutional adjustments and effective student engagement and for program’s continuous improvement.

Curriculum Review

Aligned with the CHED Memorandum Order (CMO) No. 37, s. 2012, the curriculum must adhere to Outcome-Based Education (OBE) principles. And mapping course outcomes to program outcomes ensures subjects remain relevant, credit-justified, and support essential Industrial Engineering competencies such as systems thinking, quality control, and production management. The curriculum design considerations also include alignment with TESDA’s competency-based standards and GAD guidelines to ensure that both technical mastery and gender responsiveness are integrated into instructional planning and implementation.

Technology and Sustainability Integration

This pillar promotes the specification and utilization of modern design and manufacturing tools, such as CAD/CAM, 3D modeling, and digital fabrication technologies. Where sustainability is embedded through eco-conscious materials and green manufacturing practices, reflecting global trends in ethical production.

Competency Alignment

By reviewing and the possible integration of TESDA’s Leatherworks NC II standards with BSIE-level skills, the curriculum needs to ensure graduates will meet technical demands of the industry while maintaining the analytical capabilities expected of engineers. Focus areas include practical shoemaking, ergonomics, quality assurance, and supply chain coordination.

Phased Implementation and Specialized Courses

The development of the proposed Shoe and Leathercraft specialization under the BS Industrial Engineering (BSIE-SL) program will follow a phased implementation stage: Study and Design, Feasibility Analysis, and Implementation and Accreditation. The program is still under study and framework design, focusing on academic planning and consultation with industry partners. As part of this process, six core specialized subjects have been initially identified to guide the curriculum design. These subjects aim to combine fundamental industrial engineering concepts with practical applications in footwear and leathercraft. The goal is to produce students which are equipped with relevant technical skills while addressing the specific needs of the local industry. This phased approach allows the institution with endless possibilities to build the program gradually which includes careful attention to academic standards, industry alignment, and future accreditation requirements.

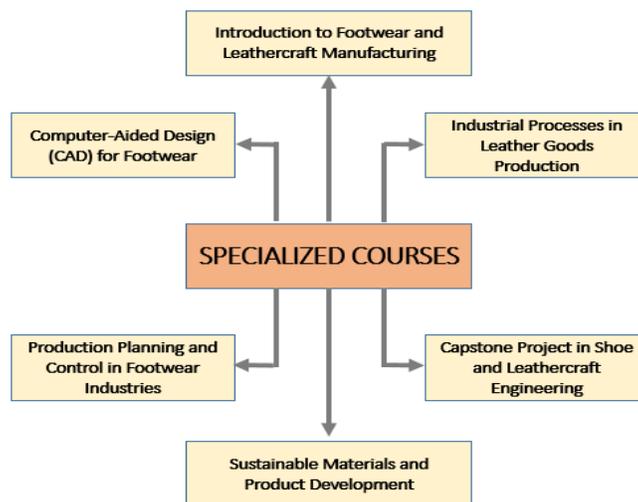


Figure 5. *Proposed Curriculum Design Considerations in Specialized Courses for Designing the Shoe and Leathercraft Specialization under the BSIE-SL Program*

Since the curriculum design for the proposed BSIE-SL program is still in the review and design

phase and as part of this ongoing process, six specialized subjects have been identified: Introduction to Footwear and Leathercraft Manufacturing, Industrial Processes in Leather Goods Production, Computer-Aided Design (CAD) for Footwear, Sustainable Materials and Product Development, Production Planning and Control in Footwear Industries, and a Capstone Project in Shoe and Leathercraft Engineering. These subjects aim to provide both basic and applied skills that match the needs of the local footwear industry. The curriculum will be developed in reference to CHED's outcomes-based education framework and will include ongoing faculty development and certifications to meet current industry and academic standards for the possible program offering.

Technology Integration and Facility Requirements

As part of the proposal in curriculum design, the integration of digital technologies into traditional shoe and leathercraft training is considered essential and relevant. To align with Industry 4.0, students will be introduced to tools such as computer-aided design (CAD) for footwear, 3D printing for prototyping, and basic materials simulation. These kind of advanced technologies are widely used in global footwear production and are necessary to prepare graduates for the demands of modern manufacturing. It is suggested that the Institution (MPC) establish an e-laboratories equipped with CAD/CAM software, precision cutting tools, industrial stitching machines, and finishing equipment to simulate actual production environments. Participation of Marikina-based manufacturers is also being planned to strengthen partnerships and ensure that students are exposed to real production settings, making their training more relevant, unique and practical. The design will be guided by existing national standards such as TESDA's Footwear Making NC II Training Regulations, which outline the required competencies for leathercraft and footwear production (TESDA, 2019). It will also consider university-level facilities such as those at De La Salle University, which have advanced CAD/CAM laboratories used in manufacturing and industrial engineering programs (De La Salle University, 2023). Moreover, global studies highlight how CAD/CAM technologies have transformed footwear production in Italy and Portugal by improving precision, reducing waste, and shortening prototyping times (Caligiuri et al., 2019; Monteiro et al., 2020), which provides a model for how MPC can adapt similar practices.

Industry Collaboration and Faculty Development

Effective academic design requires robust linkages with industry stakeholders. This proposal supports building curriculum co-design initiatives and dual-training models, where Marikina-based footwear manufacturers contribute to real-world learning through internships, immersion programs, and prototype-based projects. DTI has identified key partners within Marikina's shoe industry who have shown interest in supporting such collaborations through trade advocacy and education campaigns aligned with industry cluster development (Department of Trade and Industry, 2021; 2023). At the same time, faculty development is essential to ensure effective delivery of the specialization. Instructors must receive training in lean manufacturing practices, sustainable design principles, and emerging material technologies so they can integrate theoretical instruction with hands-on applications (Detyna, 2023).

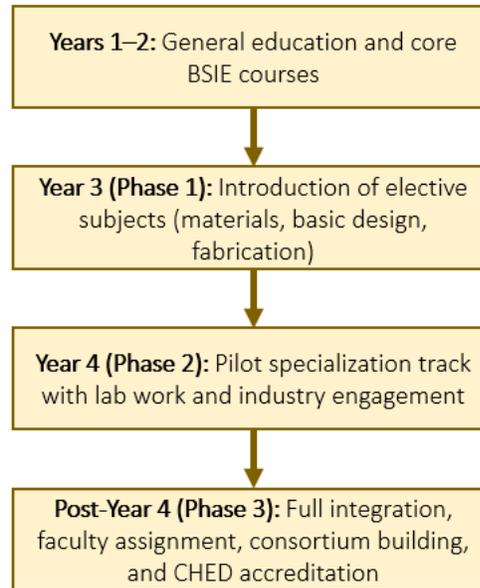


Figure 6. *Proposed Phased Academic Integration for Designing the Shoe and Leathercraft Specialization under the BS Industrial Engineering (BSIE-SL) Program*

The phased plan is organized by academic year: (1) Years 1–2: General education and core BSIE courses, (2) Year 3 (Phase 1): Introduction of elective subjects (materials, basic design, fabrication), (3) Year 4 (Phase 2): Pilot specialization track with lab work and industry engagement, and (4) Post-Year 4 (Phase 3): Full integration, faculty assignment, consortium building, and CHED accreditation. This structured approach ensures gradual capacity building, quality assurance, and responsiveness to both academic and industry feedback, ultimately supporting a viable and impactful engineering specialization at MPC.

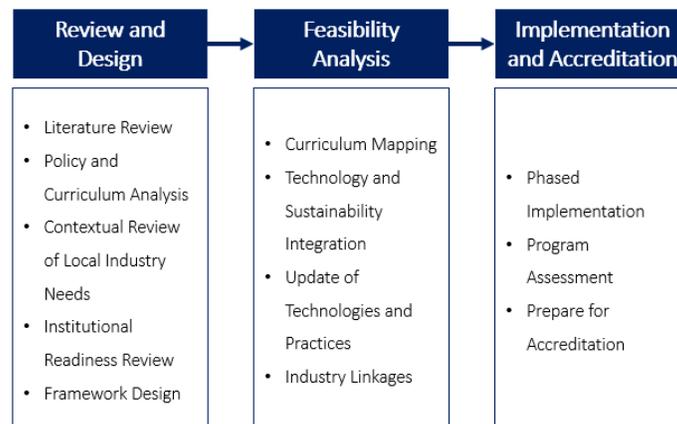


Figure 7. *Overall Research Framework for Designing the BSIE Specialization in Shoe and Leathercraft at Marikina Polytechnic College*

The proposed framework for designing the BS Industrial Engineering specialization in Shoe and Leathercraft at Marikina Polytechnic College follows a three-phase structure. It begins with Review and Design, encompassing literature reviews, policy and curriculum analyses, industry-context evaluations, institutional readiness assessments, and framework development; all aligned with national standards and Marikina's local requirements (Irving et al., 2015; CHED, 2014). The Feasibility Analysis phase assesses implementation practicality through alignment with CHED's outcomes-based education framework, integration of sustainable manufacturing technologies, technological updates, and reinforcement of industry partnerships to ensure student preparation matches market demands (Laguador and Dotong, 2014; Department of Trade and Industry, 2021). This stage also prioritizes the regular upgrade of instructional tools and laboratory resources to keep pace with innovation. In the final phase; Implementation and Accreditation, methodical rollout begins with pilot classes, electives supported by labs and industry immersion, and feedback loops that refine the curriculum before formal CHED accreditation submission. This structured process aims not only to assure academic rigor and compliance but also to revitalize Marikina's heritage shoemaking industry through a unique engineering specialization (Fabunan, 2019).

CONCLUSIONS

The research study discusses the design of a specialization in Shoe and Leathercraft under the Bachelor of Science in Industrial Engineering (BSIE-SL) program at Marikina Polytechnic College (MPC). As the "Shoe Capital of the Philippines," Marikina City also highlights the importance of bridging traditional industries with modern academic offerings most likely anchored in engineering program. Integrating heritage-based sectors into higher education contributes not only to cultural preservation but also to local economic resilience and innovation as the industry demands (Mahgoub & Alsoud, 2015; Gibbons et al., 1994).

The findings suggest that the proposed specialization is both significant and responsive to current challenges in the footwear and leathercraft sector, which the Institution is uniquely positioned to implement due to its existing technical-vocational infrastructure, location in a key industrial hub, and current academic offerings such as the BS in Entrepreneurship major in Shoe and Leathercraft Marketing. Institutional assets like the Shoe and Leathercraft Development Center (SLDC) and ReSOLES Technology Business Incubator (TBI) further enhance and showcase its capacity to support a specialized, skills-driven engineering program. In line with this, embedding such track within the BSIE program aligns with global trends in curriculum innovation that emphasize sustainable practice, design thinking, and active industry engagement (OECD, 2019; Gibbons et al., 1994; Turnšek et al., 2023). By aligning academic design with national development goals and local community needs, MPC may serve as a model for how state colleges can support traditional industries through higher education.

The design of this kind of specialization offers a timely opportunity to integrate engineering

competencies with heritage-based manufacturing, representing a practical approach to showcase a sector that remains vital to Marikina's cultural and economic identity in the country. Also considering the MPC-IoE OBE Framework and the six proposed frameworks in the study which will ensure the program's success through clear alignment of institutional capacity with industry needs, collaboration between MPC's academic units and innovation hubs, and compliance with CHED and TESDA standards. It will guide the development of specialized curricula in footwear, leathercraft, and sustainable manufacturing, support gradual implementation through phased integration, and maintain relevance through continuous research and monitoring. Together, these frameworks create a structured and sustainable approach that connects heritage, innovation, and academic excellence.

These resources provide a strong foundation for expanding into an engineering-focused specialization. Since the proposal is in startup, several steps are recommended to guide its development. (1) A formal feasibility study should be conducted, including consultations with industry partners, faculty, alumni, and students to verify demand, relevance, and sustainability while also assessing faculty capability, facilities, and labor market alignment. (2) Pilot elective subjects may be introduced in the third and fourth years of the BSIE program, covering areas such as footwear CAD design, leather materials, and production systems, with feedback from these classes informing continuous curriculum improvement. (3) Strengthening industry partnerships is also essential by collaborating with local manufacturers and industry groups to support internships, co-developed course materials, and lab-based training using real production tools and environments. (4) Investing in faculty and facility development is crucial, ensuring that instructors are trained in current footwear and leathercraft technologies while facilities are upgraded with appropriate machines, software, and equipment to support both design and production activities. (5) The curriculum design should align with CHED's outcomes-based education standards for engineering programs while also considering TESDA frameworks where applicable. (6) And the program should be implemented in phases, beginning with elective modules and laboratory upgrades, gradually moving to pilot implementation, and eventually pursuing formal CHED recognition once the program demonstrates readiness and feasibility.

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