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Institutional Strategies in Vocational Railway Schools of the Ministry of Transportation in the Era of the Industrial Revolution 4.0

Windi Nopriyanto[1*], V.Rudy Handoko[2], Ayun Maduwinarti[3], Alamsyah[4]
Politeknik Perkeretaapian Indonesia Madiun
Corresponding Author: Windi Nopriyanto windi.nopriyanto@gmail.com

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A B S T R A C T

The Indonesian Railway Polytechnic (PPI) Madiun plays a crucial role in preparing skilled workers for the railway industry. However, challenges such as a gap between the curriculum and industry needs, a lack of qualified lecturers in technology, insufficient educational facilities, and limited industry partnerships have emerged in the era of the Industrial Revolution 4.0. This study uses a SWOT analysis to explore strategies for institutional development at PPI Madiun. Data collection methods include interviews, observations, and document analysis. Despite challenges, PPI Madiun has significant opportunities to excel by enhancing its curriculum, improving faculty skills, expanding industry partnerships, and fostering innovation. Adaptive strategies are essential to ensure PPI Madiun produces competent graduates ready for the industry 4.0 challenges.

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INTRODUCTION

With the development of technology in the era of the Industrial Revolution 4.0, the railway industry has undergone significant transformation. Innovations such as the Internet of Things (IoT), Artificial Intelligence (AI), data analytics, and automation have impacted production processes, equipment maintenance, logistics management, and customer service in this sector. Demand for New Skills These changes require new skills from workers in the railway industry. In addition to more advanced technical skills, such as programming and IoT-related software maintenance, stronger soft skills like adaptability, problem-solving, and collaboration are also needed (Suhendar, Acep, 2021). According to Luturlean, B. S., & Se, M. M. (2019), the Ministry of Transportation's Railway Vocational School plays an important role in preparing future workers to meet industry demands. However, with rapid changes in industry and technology, it is crucial to evaluate to what extent graduates from this institution meet the expectations and demands of the current industry.

The Industrial Revolution 4.0 has brought significant changes to various sectors, including education. Rapid technological advancements present many opportunities, but also pose challenges that the education sector must address (Pratama, H. A., & Iryanti, H. D., 2020).

Problems Faced by the Ministry of Transportation's Railway Vocational School in the Industrial Revolution 4.0 Era

1. Gap Between Curriculum and Industry Needs
   The current Ministry of Transportation curriculum is still largely focused on railway theory and basic practical training. This does not align with the growing industry demand for skilled workers in digital technologies, such as IoT, Big Data, and Artificial Intelligence (AI).
2. Lack of Competent Lecturers in the Latest Technologies
   Most Ministry of Transportation lecturers come from experienced railway practitioners. However, they may not have adequate knowledge and skills in the latest technologies, making it difficult for them to teach courses related to these technologies.
3. Insufficient Educational Facilities
   The educational facilities, such as laboratories and the latest practical equipment, are still lacking. This makes it difficult for students to gain optimal learning experiences.
4. Lack of Industry Collaboration
   Collaboration between the Ministry of Transportation and the railway industry is still not optimal. This limits students' opportunities for internships, both domestically and internationally.

Problem Formulation

Based on the background above, the research problem is: What are the institutional strategies of the Indonesian Railway Polytechnic (PPI) Madiun in the Industrial Revolution 4.0 Era? Objective To analyze and describe the institutional strategies of the Indonesian Railway Polytechnic (PPI) Madiun in the Industrial Revolution 4.0 Era.

LITERATURE REVIEW

According to Suaedi, F. (2019), public management is a discipline that focuses on managing organizations and the public sector by applying management principles to achieve public interest-oriented goals. Dwight Waldo defines public management as a field of study that examines how public organizations operate and how they can be optimized. Donald Kettl states that public management is the art and science of managing human and financial resources to achieve politically established objectives, while Nicholas Henry describes public management as the theory and practice used to manage organizations and the public sector.

Riniwati, H. (2016) identifies factors influencing public management, describing it as a complex and dynamic field influenced by various internal and external factors. The main factors that can affect the effectiveness and efficiency of public management include:

Internal Factors:

1. Vision, Mission, and Goals: Clear and measurable vision, mission, and goals are fundamental to effective public management. These must be agreed upon by all stakeholders and communicated effectively to all employees.
2. Organizational Structure: An appropriate organizational structure can help public organizations achieve their goals effectively and efficiently. The structure must consider factors such as the size of the organization, task complexity, and span of control.
3. Human Resources: Quality human resources are an essential asset for public organizations. They must have effective recruitment, training, and development processes to ensure they have competent and motivated employees.
4. Organizational Culture: A positive organizational culture can enhance employee morale, productivity, and innovation. Public organizations should strive to create a culture that supports values such as accountability, transparency, and public service.
5. Systems and Procedures: Effective systems and procedures can help public organizations operate efficiently and effectively. These should be designed to support the organization's vision, mission, and goals.
6. Information and Communication Technology (ICT): ICT can help public organizations improve their operational effectiveness and efficiency. They should use ICT to automate tasks, enhance communication, and provide better services to the public.

External Factors:

1. Political Environment: The political environment can influence public management in several ways, such as resource allocation, regulation, and oversight. Public organizations must understand the political landscape and adapt to changes.
2. Economic Environment: The economic environment can affect public management in various ways, including resource allocation and demand for public services. Public organizations must understand the economic landscape and manage their resources effectively.

3. Social Environment: The social environment can impact public management in terms of demand for public services and public expectations. Public organizations need to understand the social context and respond to public needs and expectations.
4. Globalization: Globalization can influence public management in several ways, including competition for resources and heightened public expectations. Public organizations must understand the impacts of globalization and be able to compete globally.

Institutional Theory

1. Old Institutionalism: This theory focuses on how institutions influence individual and organizational behavior. Key concepts include:
    a. Norms and Values: Institutions are viewed as a set of norms and values that shape individual behavior.
    b. Formal and Informal: Institutions consist of formal rules (such as laws and regulations) and informal rules (such as customs and traditions).
    c. Social Influence: Individual behavior is influenced by the social and cultural structures of the institutions they inhabit.
    d. New Institutionalism: This theory emphasizes the cognitive and cultural roles in shaping institutions. Variants include:
2. Sociological Institutionalism: Highlights how norms, values, and social beliefs affect organizational behavior. Institutions are seen as cognitive frameworks that provide meaning and legitimacy.
    a. Economic Institutionalism: Combines economic perspectives with institutional analysis, focusing on how institutions reduce uncertainty and transaction costs in the economy.
    b. Rational Choice Theory: Focuses on how institutions shape individual behavior through incentives and sanctions, including contract analysis, property rights, and game theory.
    c. Institutional and Organizational Theory: This theory examines how organizations adapt and change within institutional contexts. Key concepts include:
3. Institutional Isomorphism: The process by which organizations become more similar to one another due to institutional pressures, including coercive (laws and regulations), normative (professional standards), and mimetic (imitation of best practices).
    a. Legitimacy: The process through which organizations gain support and acceptance from stakeholders by aligning with institutional norms and expectations.
    b. Interests and Power: How the interests and power of actors within organizations shape and are shaped by institutions.

Fatimah, F. N. A. D. (2016) explains that SWOT analysis is a strategic management tool used to evaluate strengths, weaknesses, opportunities, and threats affecting an organization, project, or business situation. It helps organizations understand internal and external factors influencing their performance and formulate effective strategies to achieve their objectives. Here's a brief explanation of each element of SWOT analysis:

1. Strengths: These are positive internal aspects of the organization or situation that provide a competitive advantage. Strengths may include strong resources, technological advantages, good reputation, or specialized expertise.
2. Weaknesses: These are negative internal aspects of the organization or situation that may hinder goal achievement or create competitive disadvantages. Weaknesses can include resource limitations, lack of skills or experience, complex organizational structures, or inefficient processes.
3. Opportunities: These are external factors that are favorable to the organization or situation and can be leveraged to achieve goals. Opportunities may include changing market trends, new technological developments, government regulatory changes, or emerging market needs.
4. Threats: These are external factors that may negatively impact the organization or situation and hinder goal achievement. Threats can include intense competition, changes in government policies, shifts in consumer preferences, or economic and political risks.

Politeknik Perkeretaapian Indonesia Madiun (PPI Madiun)

Politeknik Perkeretaapian Indonesia Madiun (PPI Madiun) is one of the campuses under the Vocational School of Railways (SVKP) of the Ministry of Transportation of the Republic of Indonesia. PPI Madiun focuses on vocational education and training in the railway sector.

Era of the Fourth Industrial Revolution

The Fourth Industrial Revolution is a period of technological transformation that changes how we work, live, and interact. It is characterized by the integration of digital technologies that allow connectivity between physical, digital, and biological systems. Some hallmark features of the Fourth Industrial Revolution include:

1. Internet of Things (IoT):
   IoT is a network of physical devices connected through the internet, allowing data exchange and automated control. In this era, everything from household appliances to industrial infrastructure can connect and communicate online.
2. Artificial Intelligence (AI):
   AI refers to the ability of computers to perform tasks typically requiring human intelligence, such as voice recognition, decision-making, and problem-solving. In the Fourth Industrial Revolution, AI is increasingly applied across various industries to enhance efficiency and productivity.

3. Digital Manufacturing:
   Digital manufacturing involves using digital technologies, such as 3D modeling, robotics, and smart sensors, to improve production processes. This includes concepts like smart factories that utilize data and analytics to optimize operations.

Here are some previous studies that explore the strategies developed by Indonesian universities in facing the challenges of the Fourth Industrial Revolution (Industry 4.0):

Challenges in the Era of the Fourth Industrial Revolution and the Implementation of Research-Based Learning Policies in Higher Education: Universities are required to provide the necessary learning infrastructure to produce graduates skilled in data literacy, technological literacy, and human literacy to meet the challenges of Industry 4.0.

SWOT Analysis of the Diploma III Program in Administrative Management at Universitas Sebelas Maret Surakarta in Facing the Fourth Industrial Revolution: A comprehensive SWOT (Strength, Weakness, Opportunity, and Threat) analysis of the Diploma III in Administrative Management program at Universitas Sebelas Maret Surakarta helps to identify the current state of the university and the program in facing Industry 4.0.

Education and Challenges of Technology-Based Learning in the Era of Industry 4.0: Indonesian higher education institutions have responded to the challenges of Industry 4.0 by enhancing human resource skills and competencies through education. This strategy aims to produce competent operators and analysts in educational management as drivers of progress in technology-based education.

The Fourth Industrial Revolution Era: Challenges and Opportunities in Improving Educational Literacy: The challenge for higher education in this era lies in changing learning methods, thinking patterns, and student behavior. Educators must improve their understanding of media literacy and digital literacy to help students solve academic problems effectively.

Strategies of Vocational Colleges in Facing the Challenges of Industry 4.0: Vocational colleges need to act as engines of disruptive innovation to transform mindsets, organizational work processes, productivity, and innovation to tackle the challenges of Industry 4.0. This includes revising teaching methods, curricula, and materials to align with industry needs and ensuring competency certification for both faculty and students.

Organizational Design in Higher Education Institutions in the Era of Industry 4.0: The era will bring shifts in power, wealth, and knowledge. Higher education must be equipped to compete, adapt curricula to industry standards, and refresh management practices to ensure that technological advances benefit all. What distinguishes this study is its comprehensive institutional strategy in the context of vocational railway schools in the Ministry of Transportation during the Industry 4.0 era.

METHODOLOGY

This research uses a qualitative approach to understand the perspectives and perceptions of relevant stakeholders. The study focuses on the Indonesian Railway Polytechnic (PPI) Madiun, under the Ministry of Transportation, aiming to analyze the current institutional strategies of PPI Madiun. The research informants are members of the organizational structure at PPI Madiun, selected using purposive sampling, where individuals are chosen for their specific understanding of the research problem. Data collection methods include in-depth interviews with graduates, observation of the learning process, and document analysis of school curricula and evaluation reports. Data analysis involves data reduction, data display, and conclusion drawing and verification. The validity of the data is ensured through prolonged observation and triangulation, which checks data from various sources, methods, and times.

RESEARCH RESULT AND DISCUSSION

With this background, the research aims to answer the question: What are the institutional strategies at the Indonesian Railway Polytechnic (PPI) Madiun in the Era of Industry 4.0? The objective is to analyze and describe the institutional strategies employed by PPI Madiun during this transformative period. SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) is a tool used to assess the strengths, weaknesses, opportunities, and threats faced by an organization. SWOT analysis can assist organizations in developing appropriate strategies to achieve their goals. By identifying internal strengths and weaknesses, along with external opportunities and threats, PPI Madiun can formulate effective strategies to navigate the challenges posed by Industry 4.0. This framework enables the institution to leverage its strengths, address weaknesses, seize opportunities, and mitigate potential threats, ensuring it remains competitive and relevant in the evolving educational landscape.

Table.1 SWOT Analysis Table Strengths, Weaknesses, Opportunities, Threats

Strengths	Weaknesses
1. Good Reputation: PPI Madiun has a strong reputation as one of the best vocational education institutions in Indonesia. 2. Comprehensive Facilities: PPI Madiun is equipped with comprehensive facilities to support the teaching and learning process, including laboratories, workshops, and a library. 3. Collaboration with Industry: PPI Madiun has established partnerships with the railway industry to provide students	1. Limited Resources: PPI Madiun faces limitations in resources, both in terms of financial support and human resources. 2. Curriculum Not Fully Industry 4.0 Oriented: The curriculum at PPI Madiun is not yet fully aligned with the requirements of Industry 4.0. 3. Insufficient Skills of Faculty: The skills of faculty members at PPI Madiun in utilizing new

with internship opportunities and practical work experience in the field.	technologies are still inadequate.
Opportunities 1. Industry Demand for Skilled Workforce in Rail Transportation: The rail industry requires a significant number of skilled workers in the era of Industry 4.0. 2. Advancements in Information and Communication Technology: The advancements in information and communication technology can be leveraged to enhance the quality of learning at PPI Madiun. 3. Collaboration with Other Educational Institutions: PPI Madiun can establish partnerships with other educational institutions to develop education programs oriented towards Industry 4.0.	Threats 1. Competition with Other Educational Institutions: Competition with other educational institutions is becoming increasingly intense in the era of Industry 4.0. 2. Regulatory Changes: Changes in regulations in the education sector can impact PPI Madiun. 3. Economic Crisis: An economic crisis may affect the funding sources for PPI Madiun.

Strategies to Strengthen Strengths:

1. Strengthen reputation by continuously improving the quality of education, establishing broader collaborations with the industry, and actively participating in various railway-related activities.
2. Enhance faculty quality by providing ongoing training and seminars on new technologies and modern pedagogy.
3. Periodically update the curriculum to include materials on new technologies such as the Internet of Things (IoT), Big Data, and Artificial Intelligence (AI).
4. Expand partnerships with the railway industry to provide more extensive internship opportunities and fieldwork experience for students.

Strategies to Address Weaknesses:

1. Increase financial resources by seeking alternative funding sources from outside the government, such as from the railway industry, alumni, or through partnerships with private entities.
2. Improve human resources by recruiting new faculty members who are competent in new technologies and modern pedagogy, as well as enhancing the skills of existing faculty through training and seminars.

3. Enhance faculty skills by providing ongoing training and seminars on new technologies and modern pedagogy, and encouraging faculty to keep up with the latest technological developments in the railway sector.

Strategies to Capitalize on Opportunities:

1. Develop industry-oriented education programs for Industry 4.0, such as diploma programs and applied bachelor's programs focused on new technologies and industry needs.
2. Utilize information and communication technology to improve the quality of learning, such as through e-learning and virtual learning platforms, as well as developing digital platforms to facilitate information access and communication for students and faculty.
3. Collaborate with other educational institutions to develop industry-oriented education programs and facilitate student and faculty exchanges to enhance knowledge and skills.

Strategies to Address Internal Threats:

1. Increase financial resources: PPI Madiun can seek alternative funding sources from outside the government, such as from the railway industry, alumni, or through partnerships with private entities.
2. Foster a culture of innovation: PPI Madiun can encourage a culture of innovation by rewarding faculty and students who excel in creating new innovations.
3. Enhance collaboration with industry: PPI Madiun can establish broader collaborations with the railway industry to gain insights into industry needs and provide students with internship opportunities and fieldwork experience.

Strategies to Address External Threats:

1. Improve competitiveness: PPI Madiun needs to continuously enhance the quality of its education by updating the curriculum, improving faculty quality, and providing modern teaching and learning facilities.
2. Build a responsive team: PPI Madiun should build a team that is responsive to changes in education regulations. This team must monitor the latest regulatory developments and prepare strategies to adapt to these changes.
3. Increase the flexibility of educational programs: PPI Madiun needs to enhance the flexibility of its educational programs to adapt easily to regulatory changes.
4. Seek alternative funding sources: PPI Madiun should seek alternative funding from outside the government, such as from the railway industry, alumni, or through partnerships with private entities.
5. Improve efficiency: PPI Madiun should enhance efficiency in managing finances and resources.
6. Develop sustainable education programs: PPI Madiun needs to develop sustainable education programs that produce graduates ready to work in the railway industry. By implementing these strategies, PPI Madiun can effectively address challenges and leverage opportunities in the current educational landscape.

CONCLUSIONS AND RECOMMENDATIONS

PPI Madiun has numerous opportunities to grow in the era of the Fourth Industrial Revolution. However, it also faces several challenges that must be addressed. By implementing the right strategies, PPI Madiun can become a leading vocational education institution that produces competent graduates prepared to tackle the challenges of Industry 4.0. By applying the strategies outlined above, PPI Madiun can minimize the impact of threats and establish itself as a prominent vocational education institution in the field of railways during this industrial revolution. Politeknik Perkeretaapian Indonesia (PPI) Madiun, as one of the vocational education institutions in the field of railways, needs to adapt to these changes in order to produce competent graduates ready to face the challenges of Industry 4.0. Adaptive strategies for PPI Madiun in the Era of the Fourth Industrial Revolution include curriculum development, improvement of lecturer skills, enhancement of cooperation with industry, increasing resources, fostering an innovation culture, and seeking alternative funding sources.

ADVANCED RESEARCH

Still conducting further research to find out more about Institutional Strategies in Vocational Railway Schools of the Ministry of Transportation in the Era of the Industrial Revolution 4.0

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