

ABSTRACT

This research aims to analyze 5G private network design and techno-economic evaluation in the Pasuruan Industrial Estate Rembang (PIER) Industrial Estate, which has an area of 500 hectares. As one of the largest industrial estates in East Java, PIER requires technology that can increase efficiency and productivity, so the implementation of 5G networks is very important in supporting the implementation of the Industrial Revolution 4.0.

The research method includes analyzing the needs of 5G networks using the 26 GHz frequency, 26 GHz frequency due to high bandwidth and low latency, supporting real-time communication in the industry. Technologies such as beamforming and massive MIMO ensure stable connectivity, and accelerate digital transformation. private network design with Urban Micro (UMI) propagation model, and techno-economic evaluation which includes aspects of Capital Expenditure (CAPEX), Operational Expenditure (OPEX), Revenue, and economic analysis indicators.

The results show 1 5G site can cover the entire PIER area of 500 hectares, supporting 1,555 administrative users and 16,611 industrial machines. signal quality shows the average value of SS-RSRP -86.66 dBm, SS-SINR i 21.75 dB, and throughput 932,988 kbps, which meets KPI standards and shows optimal network performance. The economic analysis showed investment feasibility with a Net Present Value (NPV) of Rp1,775,904,161.92, Net Present Value (NPV) of 76%, Payback Period (PP) of 1 year and 5 months, Return on Investment (ROI) of 579%, Profitability Index (PI) of 1.61, and Accounting Rate of Return (ARR) of 173%. These projections indicate the potential for significant profits and quick payback. This research contributes to supporting the implementation of Industry 4.0 at PIER by providing reliable infrastructure for automation and fast connectivity.

Keywords: *Private 5G Network, Pasuruan Industrial Estate Rembang (PIER), Techno-Economic Analysis.*