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Public-Private Partnership Pembangunan Infrastruktur: Dilema Etik dan Praktik

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ABSTRACT

Over the past decade, Public-Private Partnership (PPP) has emerged as an alternative scheme for financing government infrastructure development. This scheme addresses the fiscal limitations that constrain infrastructure development funding. However, implementing PPP contracts and collaborating with the private sector continue to generate controversy, particularly regarding public concerns about privatization and misconceptions surrounding the scheme's use. This article analyzes the challenges of PPP implementation from philosophical perspectives to understand how the government and private sector can effectively cooperate within the PPP framework. Using Popper's falsification approach, the article argues that the PPP scheme cannot be universally applied to all projects as widely explained in most feasibility studies and cost-benefit analysis. The stakeholders involved in PPP projects operate within different dimensions of ontology and axiology. Therefore, this article examines the ethical framework necessary for the specific application of PPP schemes, tailored to the unique characteristics and principles of different projects and sectors.

Keywords: Axiology; Infrastructure; Ontology; Public-Private Partnership (PPP)

ABSTRAK

Selama satu dekade terakhir, skema kebijakan *Public-Private Partnership* (PPP) menjadi salah satu alternatif pembiayaan pembangunan infrastruktur pemerintah. Skema ini menjadi pilihan inovatif dalam pembiayaan karena pemerintah menghadapi keterbatasan fiskal untuk menopang pembiayaan proyek infrastruktur. Akan tetapi, penerapan kerja sama dengan pihak swasta masih menghadapi banyak kontroversi terutama yang terkait dengan kekhawatiran masyarakat terhadap munculnya privatisasi dan miskonsepsi terhadap pemanfaatan skema tersebut. Artikel ini mengkaji problematika yang muncul dari penerapan PPP dalam perspektif filosofis untuk mengetahui bagaimana pihak pemerintah dan swasta menuangkan konsep kerja sama atau kemitraan tersebut melalui pemaknaan konsep dan konteks yang dijalankan selama ini. Melalui pendekatan falsifikasi Popper, artikel ini menjelaskan bahwa skema PPP tidak sepenuhnya menjadi kerangka umum yang dapat dijalankan pada semua proyek seperti yang banyak dijelaskan dalam studi kelayakan dan analisis biaya manfaat. Hal ini dikarenakan adanya aspek ontologi dan aksiologi yang berbeda di antara para pemangku kepentingan dalam implementasi proyek berbasis PPP. Oleh sebab itu, artikel ini membahas kerangka etik yang diperlukan dalam pemanfaatan skema PPP secara spesifik sesuai dengan karakteristik dan prinsip masing-masing proyek dan sektor.

Kata Kunci: Aksiologi; Infrastruktur; Ontologi; *Public-Private Partnership* (PPP)

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PENDAHULUAN

Pembangunan infrastruktur strategis menjadi kunci utama dalam menyukseskan pembangunan yang berkelanjutan untuk mencapai target dan sasaran Indonesia Maju 2045. Pembangunan infrastruktur tidak hanya menjadi landasan ekonomi melainkan juga penopang pembangunan nasional secara holistik terutama dalam upaya penguatan pertumbuhan ekonomi, peningkatan kualitas hidup masyarakat, pemerataan akses layanan publik, dan akselerasi daya saing ekonomi Indonesia.

Kementerian PPN (Bappenas) telah menetapkan perkiraan nilai investasi yang harus dialokasikan untuk pembangunan infrastruktur pada periode 2020-2024, yaitu mencapai Rp6.445 triliun. Sebesar 37% (atau setara Rp2.385 triliun) dari jumlah tersebut berasal dari APBN, 21% (atau sekitar Rp1.353 triliun) dari BUMN, dan 42% sisanya (atau senilai Rp2.707 triliun) membutuhkan partisipasi pihak swasta (Bappenas, 2021). Akan tetapi, guna mewujudkan target pembangunan yang masif tersebut, pemerintah masih mengalami kendala, terutama terbatasnya sumber daya dan lemahnya daya saing ekonomi.

Untuk menjembatani kesenjangan pembiayaan infrastruktur yang menjadi prioritas nasional, pemerintah mengeluarkan Perpres No. 38 tahun 2015 dan Permen PPN No. 7 tahun 2023 terkait dengan KPBU (Kerja sama Pemerintah dan Badan Usaha). Istilah KPBU sendiri diambil dari terminologi PPP *(Public-Private Partnership)*. Meskipun banyak negara-negara OECD mengadopsi skema ini, tidak sedikit kajian yang menunjukkan adanya kesuksesan dan kegagalan dalam penerapan PPP. Dinamika tersebut dipengaruhi oleh faktor dan karakteristik yang cukup beragam di tiap-tiap negara, bahkan berbeda dari sektor ke sektor dan dari proyek ke proyek.

Dalam penyelenggaraan pembangunan, pemerintah harus berfokus pada penciptaan kondisi yang mendorong dunia usaha untuk berinvestasi dan menjaga pemerataan ekonomi, termasuk perlindungan hak milik swasta, investasi di bidang infrastruktur, supremasi hukum dan penciptaan nilai tambah (Mazzucato, 2018). Sebagai konsekuensinya, upaya untuk mewujudkan transparansi dan akuntabilitas publik dari realisasi penggunaan sumber keuangan negara yang dikerjasamakan dengan pihak swasta perlu terus dilakukan (Miranda-Poggys & Morena, 2023). Bahkan, munculnya diskursus terkait keterlibatan swasta dalam proyek pembangunan dapat memicu ketidakpercayaan masyarakat akan keberlanjutan proyek pembangunan dan status kepemilikan aset pelayanan publik tersebut. Belum adanya prinsip etika dan perilaku dalam pelaksanaan kontrak PPP juga berpeluang menimbulkan konflik antara sektor publik dan swasta karena perbedaan kepentingan (Maramis, 2018).

Oleh sebab itu, tulisan ini akan mengulas pentingnya kerangka etik *Public-Private Partnership* (PPP) untuk memahami konstruksi makna, cara berpikir, dan nilai-nilai dari konsep PPP yang saat ini banyak dipromosikan dalam pembangunan proyek infrastruktur. Pada bagian awal, tulisan ini menjelaskan pemaknaan dan miskonsepsi PPP yang tengah berkembang saat ini. Pada bagian selanjutnya, tulisan ini mengulas kerangka teoritis yang terkait dengan isu etik *(ethical issues)* dari munculnya miskonsepsi PPP khususnya dalam pembangunan proyek infrastruktur. Bagian akhir tulisan ini berisi penutup atau simpulan.

KAJIAN PUSTAKA

PPP dan Keberlanjutan Neoliberalisme

Istilah PPP saat ini semakin banyak digunakan sebagai sebuah pendekatan inovatif dalam pembiayaan pembangunan infrastruktur (Rohman, 2022). Hal ini tidak bisa dilepaskan dari semakin berkembangnya perubahan struktur ekonomi global termasuk di negara berkembang yang telah mengadopsi pasar bebas secara meluas (Syahruddin et al., 2023).

Di awal abad ke-21, para ekonom politik menganalisis secara kritis dampak neoliberalisme, termasuk semakin tingginya kesenjangan pendapatan dan orientasi negara dalam mengembangkan korporasi multinasional dan modal keuangan (Brenner & Theodore, 2002; Harvey, 2005; Peck & Tickell, 2002). Salah satu kontradiksi yang mengemuka dalam proyek neoliberalisme adalah terkait dengan oposisi publik terhadap privatisasi langsung dari *Keynesian welfare-state intitutional forms* yang terjadi sekitar tahun 1990-an. Pemerintah liberal saat itu menghadapi dilema bagaimana menjamin keberlanjutan dan memperluas proyek-proyek kaum neoliberal dalam penyediaan layanan publik, infrastruktur, dan tata kelola sebagai dukungan dalam pelayanan dan dinamika publik itu sendiri. Mekanisme kebijakan baru seperti *Public-Private Partnership* (atau di UK dan Kanada yang dikenal dengan istilah *private finance initiatives*) yang selanjutnya dikembangkan pada periode 1980-an merupakan bentuk keberlanjutan proses neoliberalisasi agar dapat terus diimplementasikan di berbagai lembaga kunci khususnya di negara-negara persemakmuran.

Di Indonesia, PPP – atau yang dikenal dengan istilah Kerja sama Pemerintah dan Badan Usaha (KPBU) – merupakan strategi pemerintah Indonesia untuk mengatasi keterbatasan anggaran dan kesenjangan infrastruktur. Keterbatasan infrastruktur diketahui secara luas sebagai salah satu hambatan utama kemajuan perekonomian Indonesia. Namun, kemajuan yang dicapai masih belum memuaskan karena kinerja proyek yang didanai melalui skema tersebut belum sepenuhnya berjalan sesuai perencanaan. Berdasarkan evaluasi proyek PPP tahun 2023 (Bappenas, 2023), sebanyak 34 proyek sukses, 18 dalam tender, 50 dalam fase penyiapan, dan 16 proyek dihentikan. Hasil evaluasi ini mengindikasikan bahwa walaupun PPP telah mencatat keberhasilan pembangunan proyek infrastruktur, dalam praktiknya, kegagalan proyek PPP ternyata masih cukup tinggi.

Definisi PPP termuat dalam Perpres KPBU yang dimaknai sebagai bentuk kerja sama antara pemerintah yang diwakili oleh Menteri/Kepala Lembaga/Kepala Daerah/ Badan Usaha Milik Negara/Badan Usaha Milik Daerah dengan badan usaha swasta, berdasarkan suatu perjanjian khusus untuk menggunakan sumber daya Badan Usaha dengan memperhatikan alokasi risiko dalam rangka penyediaan layanan infrastruktur

publik (Lintang, 2022). Beberapa pemangku kepentingan di dalam kerangka PPP meliputi pejabat publik, institusi pendukung, investor, dan masyarakat. Definisi ini mengonfirmasi kajian sebelumnya bahwa PPP adalah kolaborasi antara pemerintah dengan swasta untuk membantu penyediaan jasa dan infrastruktur yang secara tradisional disediakan oleh sektor publik (Carbonara et al., 2013; Tsimoshynska et al., 2021).

PPP juga dipahami sebagai metode pengadaan alternatif untuk penyediaan barang dan jasa publik melalui peningkatan partisipasi swasta. Skema ini bertujuan untuk membawa keahlian, pengetahuan, dan sumber daya sektor swasta (keuangan dan lainnya) ke ranah publik, khususnya saat terjadi defisit anggaran dan pemotongan belanja (Miranda-Poggys & Morena, 2023).

Lubis dan Majid (2013) memperluas definisi PPP sebagai bentuk hubungan yang melibatkan proses berbagi risiko antar beberapa pihak pada periode kontrak tertentu untuk memenuhi penyediaan proyek infrastruktur publik. Namun, mereka masih mempertanyakan rasionalisasi penerapan PPP mengingat persepsi dan pemahaman umum mengenai PPP saat ini masih dalam tahap berkembang *(nurturing)*. Mereka juga mengungkapkan bahwa batasan makna dari PPP tidak hanya didasarkan pada karakteristik yang sesuai pilihan salah satu pihak karena batasan yang dibuat akan cenderung ambigu dan terlalu memihak.

Miskonsepsi *Public-Private Partnership*

Pemahaman mengenai makna dan definisi PPP merupakan hal yang penting karena tatanan struktur pelaku yang akan bekerja membutuhkan komitmen serius antara organisasi sektor publik dan organisasi lain di luar itu. Tatanan ini dibangun melalui kepakaran dan kapasitas yang memadai dan saling menguatkan dari setiap mitra proyek.

Dalam studinya, Curtain dan Betts (2017) mengungkapkan beberapa miskonsepsi mengenai konsep PPP modern di Australia. Miskonsepsi pertama adalah bahwa hanya ada satu cara untuk menggunakan skema PPP, yaitu ketika pemerintah bertanggung jawab terhadap penyediaan layanan publik dan sektor swasta hanya terlibat dalam proses desain, pembiayaan, konstruksi, pemeliharaan, hingga operasional. Kedua, tujuan PPP dipersepsikan untuk memaksimalkan transfer risiko ke swasta. Padahal dalam konteks alokasi risiko, prinsip dasar yang melandasi tatanan PPP adalah *partnership*, di mana sektor publik dan swasta harus saling bekerja sama untuk memenuhi kebutuhan infrastruktur.

Curtain dan Betts (2017) juga mengungkapkan masih adanya miskonsepsi bahwa pemerintah dapat melakukan pengadaan proyek melalui kontrak PPP apabila sumber pendanaan tidak memadai untuk melakukaan proyek tersebut secara mandiri. Menanggapi hal ini, mereka menegaskan kembali pentingnya membedakan konsep *funding* dan *financing*. Istilah pendanaan *(funding)* berkaitan dengan ketersediaan sumber daya anggaran pemerintah untuk infrastruktur. Sementara itu, pembiayaan *(financing)* merujuk pada bagaimana infrastruktur dapat dibiayai baik oleh publik maupun swasta. Miskonsepsi selanjutnya menyatakan bahwa semua skema PPP merupakan pembiayaan swasta yang berupa kontrak jangka panjang. Pada kenyataannya, proyek PPP bisa dibiayai dengan pinjaman jangka pendek (5-7 tahun) sebagaimana yang telah diimplementasikan di Australia pada tahun 2014.

Berdasarkan fenomena yang muncul mengenai pemaknaan PPP, artikel ini berupaya menjelaskan aspek ontologi untuk membahas apa yang ingin diketahui dari teori tentang “ada” atau bagaimana hakikat objek

yang ditelaah sehingga menghasilkan pengetahuan. Di samping itu, fokus terhadap aksiologi yang berkaitan dengan nilai dan kegunaan dari pengetahuan yang diperoleh juga menjadi bagian penting yang akan ditelaah lebih lanjut dalam artikel ini.

Etik dan Kepentingan Ekonomi pada PPP

Sebagai sebuah konsep, PPP memantik pertanyaan serius mengenai sifat dan pola hubungan antara etik dan kepentingan ekonomi. Asumsi dasar PPP menjelaskan bahwa otoritas publik berwenang menetapkan standar pelayanan publik dan melindungi kepentingan publik. Secara istilah, PPP mengacu kepada 'pemerintah-swasta' dan bukan 'kemitraan swasta-pemerintah'. Hal ini mengindikasikan adanya konstanta hierarkis dari hubungan keduanya. Namun, konstanta hierarkis tersebut tidak boleh digunakan oleh otoritas publik untuk melakukan dominasi terhadap pihak swasta, melainkan mereka harus saling melengkapi dan bersinergi dalam penyediaan pelayanan publik (Sredojevic & Cvetkovic, 2015).

Konstanta hierarkis ini mencerminkan opini hukum dan politik serta sistem nilai yang berlaku (Sredojevic & Cvetkovic, 2015). Mereka berpendapat bahwa konstanta hierarki dapat memastikan adanya partisipasi dan kontribusi sektor swasta yang diperlukan dalam upaya legitimasi penataan dan penerapan PPP. Hal ini disebabkan adanya sensitivitas politik di mana partisipasi swasta dalam penggunaan sumber daya publik berpotensi membahayakan legitimasi yang hanya berorientasi pada ekskalasi profit semata. Oleh sebab itu, sektor swasta perlu ditempatkan pada posisi sebagai aktor yang bertanggung jawab dalam pelaksanaan target pembangunan infrastruktur tersebut. Jika tidak, PPP hanyalah sebuah konsep yang tak bermakna (tanpa substansi dan landasan etik).

Skema PPP diprioritaskan untuk mendukung fungsionalitas dari pelaksanaan pekerjaan pemerintah. Sudut pandang etik sebagai faktor penghubung antara kepentingan publik dan kepentingan ekonomi berawal dari hipotesis bahwa perilaku ekonomi yang sejalan dengan norma-norma moral tidak hanya mengarah pada pemenuhan kepentingan umum saja, melainkan perlu melihat realisasi kepentingan sektor swasta (Kohls, 2002). Dalam praktiknya, sebagian besar pemerintah mengadopsi prinsip-prinsip PPP sebagai alasan ideologis; memanfaatkan keahlian sektor swasta untuk meningkatkan efisiensi, manajemen perubahan, dan pertumbuhan ekonomi. Karena PPP melibatkan banyak pilihan yang sulit, maka pilihan kebijakan harus dinilai secara hati-hati dan alasan yang mendukung keputusan tersebut harus masuk akal, jelas, dan kuat (Lubis & Majid, 2013; Rohman & Wiguna, 2021).

Pendekatan Konseptual

Dengan mempertimbangkan isu dan tantangan di atas, studi ini akan menganalisis konsep PPP dari sudut pandang yang lebih spesifik. Pendekatan yang digunakan dalam studi ini adalah pendekatan filsafat yang digunakan untuk melakukan analisis konten melalui metode fenomenologi. Pendekatan ini berpusat pada analisis terhadap esensi dari sebuah eksistensi yang berasal dari pengalaman yang disadari (Hasbiansyah, 2008).

Suatu fakta yang diteliti dalam perspektif ini dapat bersifat subjektif karena hal yang diungkapkan berdasarkan pengalaman dari para subjek yang mengalami fakta atau fenomena tersebut. Untuk mengatasi subjektifitas tersebut, pendekatan objektif perlu dikedepankan di mana telaah terhadap esensi sebuah fakta tidak perlu diintervensi. Untuk melengkapi tahap analisis tersebut,

kajian berfokus pada studi pustaka melalui penelusuran literatur dari berbagai jurnal dan dokumen kebijakan terkait dengan PPP.

Selanjutnya, pendekatan falsifikasi Popper digunakan untuk mengetahui bagaimana masing-masing pelaku kerja sama memaknai dan menyakini kebenaran PPP dari perspektif dan kepentingan yang berbeda. Dalam pemikirannya, Popper (1935) menyatakan bahwa kebenaran suatu teori tidak hanya didasarkan pada pembenaran atau proses verifikasinya melainkan dapat diupayakan melalui penyangkalan terhadap proposisi yang dibangun dalam teori tersebut (falsifikasi). Pendekatan falsifikasi dalam studi ini mengacu kepada cara pandang terhadap sesuatu atau kejadian berdasarkan sisi kesalahan. Popper (1935) menjelaskan bahwa sebuah teori yang tidak terbukti salah akan mengalami koroborasi (penguatan). Akan tetapi, hal ini membuka peluang bagi peneliti lain untuk mengoreksi teori tersebut ketika muncul perbedaan data yang bisa menolak *(refutations)* teori dimaksud.

Konsep falsifikasi berperan penting untuk menentukan rasionalitas dan validitas dari definisi PPP yang berbeda dari konsep privatisasi. Meskipun banyak studi menelaah definisi dan makna PPP secara spesifik, teori mengenai konsep ini belum sepenuhnya baku. Oleh sebab itu, cara rasional untuk memahami teori atau konsep memerlukan konsistensi dan dapat dilakukan perbaharuan melalui tahap falsifikasi.

Pandangan Popper (1935) ini memiliki kesamaan esensi dengan konsep PPP yang banyak dibahas di kalangan *neoliberal.* Melalui konsep dan pemikiran Popper (1935), artikel ini akan mengurai fenomena kemitraan dalam PPP sebagai bentuk baru *neoliberalisme* yang sebelumnya dikenal dengan privatisasi. Konsep dan makna tersebut akan dikembangkan menjadi kerangka etis untuk menganalisis bagaimana pengaruh kepercayaan terhadap pemaknaan sebuah konsep dan pengambilan keputusan atau tindakan yang terkait dengan fungsi dan dampak yang dihasilkan.

DISKUSI

Pemaknaan PPP *vis-à-vis* Privatisasi

Berdasarkan perspektif falsifikasi Popperian, upaya untuk menjelaskan aspek parsial dari pemaknaan PPP dapat dimulai dari bagaimana hubungan antara sektor publik dan swasta dilihat berdasarkan observasi fenomena *in concreto* yang digerakkan oleh partikularitas setiap kasus atau proyek yang mengarahkan pada pengembangan keseimbangan pemahaman antara etika Utilitarian dan etika sektor publik.

Salah satu isu penting yang pernah muncul mengenai pemaknaan PPP adalah ketika dikaitkan dengan ‘privatisasi’. Untuk menghindari oposisi publik terhadap privatisasi, PPP tidak didefinisikan sebagai privatisasi melainkan dikemas dengan istilah *partnership* atau kemitraan yang – dalam paradigma atau konteks ekonomi modern – dianggap sebagai sumber manfaat dari sektor swasta dan pasar yang diintroduksi kepada publik (Sparks, 1998).

Secara konseptual, privatisasi pada dasarnya merupakan hasil kebijakan politik karena menentukan pilihan di antara dua hal, yaitu swasta *(private)* dan govermentalisasi, yang dalam kajian ekonomi politik disebut *public choice* (Istianto, 2011; Rakhel et al., 2021). Sebagian kalangan menganggap bahwa PPP tidak sepenuhnya dapat diterapkan dalam sistem yang terstruktur secara umum dan sesuai dengan prinsip-prinsip universal. Mereka berargumen bahwa pendekatan polisentris dari PPP memiliki bentuk yang

berbeda-beda sehingga praktiknya perlu disesuaikan dengan karakteristik, ciri khas, dan kebutuhan kerja sama.

Dengan memahami nilai tambah PPP pada tataran yang lebih luas, kerangka intelektual yang menjadi landasan etik penerapan PPP dapat dibangun agar membedakannya dari privatisasi. Bagaimana prioritas pembangunan infrastruktur dapat diupayakan melalui skema ini harus dilihat dalam konteks dan dimensi relasional yang secara filosofis dipahami dan diterapkan dengan baik oleh kedua pihak.

Kerangka Etik PPP dalam Pembangunan Infrastruktur

Mengapa kerangka etik dalam PPP sangat diperlukan? Ketika proses bisnis dijalankan oleh orang-orang baik dengan nilai etik yang kuat, maka bisnis tersebut akan berpeluang besar menciptakan organisasi dengan orang-orang yang baik pula. Meski demikian, nilai dan filosofi moral masing-masing individu hanya salah satu faktor yang berperan dalam proses pengambilan keputusan yang menganut etik bisnis yang sesuai.

Kerangka etik dalam proses bisnis PPP merupakan wadah untuk menghargai keberagaman nilai-nilai individu *(personal values)* dan menyakinkan pelaku kerja sama kolektif tersebut agar berjalan berdasarkan etik organisasi masing-masing. Dari sisi pemerintah, skema pembiayaan proyek berdasarkan kontrak PPP menjadi alternatif untuk mengatasi isu keterbatasan anggaran agar dapat menjamin penyediaan layanan publik. Sedangkan dari sisi swasta, mereka berorientasi pada keuntungan dari keterlibatannya di proyek investasi tersebut.

Konsep etik dibangun berdasarkan tanggung jawab untuk menimbang nilai (*values)* dan keputusan pada situasi yang belum pernah dihadapi. Standar etik yang tinggi membutuhkan kerja sama semua pihak untuk beradaptasi dengan prinsip moral masing-masing. Kerangka etik yang dikembangkan dalam skema PPP perlu mengutamakan prinsip, nilai, dan standar yang mengarahkan perilaku mereka dalam setiap proses bisnis (Ferrell et al., 2011). Prinsip dimaknai sebagai batasan spesifik dan melekat dalam perilaku yang bersifat universal dan mutlak. Nilai *(values)* dibutuhkan untuk membangun norma yang diperkuat secara sosial. Contoh *values* dalam kerangka etik adalah integritas, akuntabilitas, dan kepercayaan. Pelaku usaha dan pemerintah memiliki nilai-nilai dasar dalam menjalankan proses bisnis, di mana setiap tindakan spesifik benar atau salah, etik atau tidak etik, akan bergantung pada pertimbangan masing-masing pihak.

Kerangka etik juga perlu dipertimbangkan secara aksiologis. Dilihat dari sudut pandang aksiologi, proses bisnis dalam pelaksanaan kontrak PPP harus melihat nilai-nilai penting yang terkait dengan keadilan, keberlanjutan, dan tanggung jawab sosial dari pembangunan infrastruktur. Pemahaman terhadap aksiologi mencakup kesadaran terhadap proses penciptaan nilai atau manfaat yang dihasilkan dari aktivitas pembangunan tersebut.

Bagi pemerintah, pengalaman menjalankan skema bisnis ini masih terbatas sehingga pengambilan keputusan dalam setiap proyek membutuhkan keahlian dan manajemen dari pelaku swasta yang dianggap lebih baik. Melalui pembelajaran ini, pihak pemerintah dan swasta akan saling belajar untuk memahami nilai dan prinsip organisasi masing-masing pihak sehingga mereka akan mengonfirmasi pengetahuan dan etik tersebut ke dalam proses dan sistem yang dijalankan. Ferrell et al. (2011) menyatakan bahwa kerangka etik ini sangat diperlukan untuk mengidentifikasi isu yang muncul dan mengenali pendekatan yang digunakan untuk mengatasi isu tersebut.

Kerangka etik dalam proses bisnis PPP diharapkan dapat menjadi fondasi dalam melaksanakan tanggung jawab sosial kepada masyarakat. Hal ini bertujuan untuk memaksimalkan dampak positif bagi pemangku kepentingan dan meminimalisir dampak negatifnya. Pihak pemerintah dan swasta akan semakin memperhatikan isu etik dalam pelaksanaan proses bisnis dan administrasi karena mereka semakin peduli dengan pandangan publik dan kebutuhan sosial yang terus meningkat.

Meskipun secara umum PPP dianggap dapat bermanfaat dalam banyak proyek, beberapa kasus lain masih mengindikasikan kegagalan, seperti pembebasan lahan yang berkaitan dengan pemangku kepentingan eksternal yaitu masyarakat sekitar proyek (Amadi et al., 2018). Hal ini dikarenakan adanya praktik manajerial yang buruk yang dilakukan oleh aktor publik dan swasta sehingga berpengaruh terhadap efisiensi dan efektifitas pelaksanaan proyek.

Kerangka etik juga sangat penting bagi organisasi dalam rangka menghadapi isu *moral hazard* dari berbagai kepentingan. Di satu sisi, *moral hazard* berkaitan dengan keyakinan dan kepercayaan pelaku publik (pemerintah) kepada sektor swasta dan bagaimana komitmen dan kemampuannya untuk mewujudkan sasaran pembangunan yang tidak hanya berorientasi profit namun juga untuk pemenuhan kepentingan publik yang lebih luas. Di sisi lain, bagi pelaku swasta, *moral hazard* menjadi sumber ketidakpastian terhadap perlakuan yang adil sekaligus menjadi potensi dan diskresi dari peraturan dan aktivitas yang berubah sewaktu-waktu.

Dalam pasar politik, di mana kinerja aktor publik dinilai dan diukur oleh pemangku kepentingan, tidak ada hukum penawaran dan permintaan yang jelas dan dapat diterapkan. Sebaliknya, dinamika pasar politik berupaya untuk mengatur aktivitas publik melalui kemampuan mereka dalam meningkatkan kualitas dan layanan publik, serta upaya pemerintah untuk melindungi barang publik tersebut.

Pada bagian ini, fokus studi juga diarahkan pada konsep pemangku kepentingan *(stakeholders)* dan memahami bagaimana kerangka pemangku kepentingan tersebut akan membantu menjelaskan etik organisasi yang dibutuhkan. Miranda-Poggys dan Morena (2023) mengungkapkan bahwa implikasi kerangka kebijakan publik terhadap nilai-nilai nonfinansial sangat penting bagi akuntabilitas PPP terutama dalam bidang sosial dan lingkungan. Melalui kerangka ini, tanggung jawab sosial dan segala dimensi yang melingkupinya dapat ditelaah lebih lanjut. Sebagai contoh, tata kelola korporasi *(corporate governance)* merupakan salah satu dimensi dari tanggung jawab sosial dan pengambilan keputusan etik yang digunakan untuk memahami pentingnya tanggung jawab pada pemangku kepentingan atau isu-isu sosial yang berkembang (Ferrell et al., 2011).

Prinsip-prinsip Pengembangan Kerangka Etik PPP

Sejalan dengan pendekatan Popper, terdapat beberapa prinsip pengembangan kerangka etik PPP yang relevan untuk mendukung proses bisnisnya.

1. Pertimbangan secara konkret terhadap nilai dan tujuan politik dari aktor publik, dan bagaimana perilaku dari pihak swasta. Sebagaimana telah diuraikan pada bagian sebelumnya, munculnya miskonsepsi tentang peran sektor swasta dalam PPP yang hanya dilibatkan untuk mendukung kepentingan sektor publik sangat perlu diperhatikan. Hal ini berimplikasi pada nilai-nilai publik dan politik yang akan melekat pada kerangka

tujuan sektor publik dan kemudian dituangkan dalam sistem nilai yang dijalankan oleh pihak swasta.

2. Penentuan skema PPP yang relevan dapat dilakukan melalui penerapan metode Popperian dengan mengacu pada bentuk dan karakteristik dari skema yang spesifik. Melalui kerangka etik yang tepat, penggunaan skema PPP tidak akan diterapkan pada semua jenis proyek infrastruktur (menghindari *one size fits all*) atau dalam jangka panjang saja.

3. Pengembangan kerangka etik dijalankan oleh pemangku kepentingan yang relevan dari pihak pemerintah dan swasta sesuai kapasitas dan tanggung jawab sosial masing-masing. Menurut definisi Dworkian tentang interpretasi kebenaran, terdapat dua prakondisi dalam situasi *sine qua non*, yaitu adanya tanggung jawab dari interpreter dan sistem nilai yang diyakini oleh interpreter (Dworkin, 2009). Dalam hal ini, interpretasi kerangka etik dari proses bisnis PPP merupakan tanggung jawab dari interpreter yang bekerja sama, yaitu pihak publik dan swasta. Untuk mencapai tujuan bersama, mereka tak lepas dari keberadaan nilai-nilai sosial di masyarakat karena melibatkan kepentingan publik di mana proyek PPP akan dijalankan.

Apabila nilai-nilai dasar tersebut dipahami dan diimplementasikan dengan baik oleh pelaku yang terlibat dalam PPP, maka kontrak PPP dapat menjadi semacam kesepakatan yang bersifat *self-enforced*. Pada gilirannya, dialektika tersebut dapat membentuk pemahaman tentang PPP menjadi sebuah skema pembiayaan yang dikonstruksi sebagai *self-adaptive system.*

Adanya perbedaan perspektif antara pemerintah dan swasta terhadap akuntabilitas, tujuan, dan motivasi masing-masing pelaku sangat berkaitan dengan analisis PPP. Di satu sisi, perusahaan swasta berorientasi pada optimalisasi keuntungan. Di sisi lain, entitas publik harus terlibat dalam layanan yang melindungi dan meningkatkan nilai-nilai warisan lingkungan, sosial, dan budaya. Oleh sebab itu, dimensi nilai kontekstual PPP dan bagaimana nilai-nilai nonfinansial diperhitungkan dalam kaitannya dengan hal tersebut perlu dipahami dengan baik oleh kedua belah pihak yang bekerja sama (McDonald-Kerr, 2017).

PENUTUP

Hingga saat ini, PPP telah menjadi salah satu skema pembiayaan alternatif untuk infrastruktur dan penyediaan layanan publik (Willems et al., 2017). Oleh sebab itu, PPP memiliki tanggung jawab sosial dan potensi etik di ranah publik yang diukur dengan metrik pasar (Brown, 2015). Hal ini menyebabkan munculnya konsepsi baru mengenai akuntabilitas dan manfaat PPP bagi kepentingan publik yang tidak ditemukan pada konsep terdahulu (Shaoul et al., 2012; Stafford & Stapleton, 2017).

Berbagai studi menunjukkan adanya sejumlah aspek yang mengkaji dimensi ekonomi dan keuangan dalam pengambilan keputusan terkait PPP, namun hanya sedikit penelitian yang mempertimbangkan dampak sosial, lingkungan, serta penilaiannya (Cui et al., 2018). Pengelolaan dan penyelenggaraan pemerintahan perlu mengedepankan kepentingan publik dan perubahan ke arah paradigma baru, yaitu *"valuing people, not just productivity"*. Dengan kata lain, pergeseran orientasi pemerintah dalam mengelola kepentingan publik harus berdasarkan regulasi yang memprioritaskan nilai sosial masyarakat daripada sekadar orientasi produktivitas agar nilai-nilai sosial tersebut tidak hilang dari jati diri bangsa.

Peran dari pemerintah dan swasta dalam PPP dapat memberikan gambaran mengenai perbedaan batasan etik berdasarkan regulasi yang mendasari peran para pihak. Ketika pemerintah terikat dalam kontrak, maka perbuatan hukum pemerintah bersifat perdats yang harusnya memiliki kedudukan yang sama dengan swasta. Tidak ada pengecualian di dalamnya karena dilakukan oleh badan publik atau karena objek perjanjiannya adalah infrastruktur publik (Sebayang & Sebayang, 2020).

Walaupun pemerintah terus mendorong pembiayaan proyek infrastruktur dengan skema kerja sama dengan pihak swasta, pemerintah melalui Kementerian Keuangan, Bappenas, Kemenko Perekonomian, dan kementerian teknis lainnya perlu membangun kerangka evaluasi dan penilaian dari setiap proyek infrastruktur berdasarkan prinsip-prinsip etik dan moral. Dengan evaluasi dan penilaian tersebut, pemerintah juga dapat mengidentifikasi *balance development* dari capaian atau target pembangunan yang telah dilaksanakan.

Isu etik yang diangkat dalam PPP dianggap lebih kontroversial apabila dikaitkan dengan kemitraan swasta walaupun etik yang terkait dengan konteks ekonomi sebenarnya merupakan pemanfaatan barang publik *(prima facie utilitariasm)* yang merupakan karakter wajar dari hasil etik tersebut *(consequential ethics)*. Dalam konteks PPP, pihak swasta sebagai investor diharapkan dapat memenuhi unsur solidaritas, keadilan, dan *mutual respect* untuk memaksimalkan manfaat dari PPP secara keseluruhan. Selain itu, sektor swasta termasuk Badan Usaha Milik Negara (BUMN) yang bertanggung jawab dalam pelaksanaan proyek diharapkan dapat mendorong keadilan sosial yang kompetitif daripada sekadar mengutamakan keadilan institusional yang abstrak.

Etik yang dikembangkan dalam PPP saat ini diharapkan dapat meraih dukungan publik sebagai bentuk kepercayaan *(trusted goods)* yang akan dijalankan oleh semua lembaga yang terlibat, tak terkecuali PT PII dan PT SMI sebagai lembaga pemerintah yang menjamin pembiayaan dan keberlanjutan pelayanan publik. Oleh sebab itu, dalam pengembangan konsep PPP, semakin besar kekuatan ekonomi suatu negara, semakin besar pula tanggung jawab pemangku kepentingan untuk berkontribusi dalam penyediaan barang publik.

TENTANG PENULIS

Lutfah Ariana adalah peneliti bidang Kebijakan Iptek dan Inovasi di Badan Riset dan Inovasi Nasional (BRIN). Saat ini, penulis sedang menempuh pendidikan doktor bidang Ilmu Ekonomi di Fakultas Ekonomi dan Bisnis, Universitas Gadjah Mada (UGM) Yogyakarta. Penulis menekuni bidang *knowledge management, economics of innovation,* dan studi inovasi. Untuk komunikasi lebih lanjut, pembaca dapat menghubungi alamat surel penulis: lutfah.ariana@mail.ugm.ac.id.

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Infrastruktur Konektivitas, Peran Pemerintah, dan Perkembangan Sosial Ekonomi Regional: Bukti dari Kalimantan

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ABSTRACT

The Island of Kalimantan, designated by the Indonesian government as the site for the new capital city, necessitates significant infrastructure improvements to support its economic development. This research evaluates the progress of the connectivity infrastructure in Kalimantan, reviews the role of the government in facilitating this development, and estimates the relationship between infrastructure and the community's social and economic activities. The study applies descriptive statistics, correlation analysis, comparative studies, and interregional input-output methodology by utilizing various data sources including the central government budget, regional government budget, village potential data, Susenas, and Geographic Information System (GIS) data. Our findings reveal increasing budgets from both central and local governments, yet limited improvements in road infrastructure. An increase in the availability of road infrastructure per km² is positively correlated with enhanced trading activities, the provision of shops, improved public transportation, and better access to education and health facilities. In addition, the establishment of airports and ports is linked to higher per capita income and increased service and manufacturing activities, as well as the growth of food stalls, shops, and banking services.

Keywords: Airport; Harbor; Infrastructure; Road

ABSTRAK

Pulau Kalimantan yang ditetapkan oleh pemerintah sebagai wilayah yang terdapat Ibu Kota Nusantara memerlukan peningkatan infrastruktur untuk menunjang perekonomian. Penelitian ini mengkaji perkembangan infrastruktur konektivitas di Kalimantan, peran pemerintah dalam mendukung perkembangan infrastruktur, dan estimasi hubungan infrastruktur dengan aktivitas sosial dan ekonomi masyarakat. Penelitian menggunakan metode deskriptif statistik, korelasi, perbandingan, serta *Interregional Input-Output* dengan memanfaatkan beragam data, termasuk anggaran pemerintah pusat, pemerintah daerah, potensi desa, Susenas, dan *Geographic Information System* (GIS). Kami menemukan adanya penambahan anggaran pemerintah pusat dan daerah, namun peningkatan infrastruktur jalan masih terbatas. Peningkatan ketersediaan infrastruktur jalan per km² berhubungan dengan meningkatnya aktivitas perdagangan, pertokoan, transportasi publik, serta akses pada fasilitas pendidikan dan kesehatan. Keberadaan bandara dan pelabuhan berhubungan dengan besarnya pendapatan per kapita masyarakat, aktivitas jasa dan manufaktur, warung, pertokoan, dan perbankan.

Kata Kunci: Bandar udara; Infrastruktur; Jalan; Pelabuhan

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PENDAHULUAN

Infrastruktur merupakan salah satu faktor penentu daya saing dalam meningkatkan pertumbuhan ekonomi (Wang et al., 2021), membuka lapangan pekerjaan (Brooks et al., 2021; Zhu et al., 2009) dan mengurangi jumlah penduduk miskin (Chotia & Rao, 2017). Pemerintah pusat dan pemerintah daerah (provinsi/kabupaten/kota) terus berupaya melakukan pembangunan infrastruktur secara masif sesuai dengan kewenangan yang dimilikinya.

Penelitian terdahulu tidak banyak mengkaji hubungan antara infrastruktur, ekonomi, dan peran pemerintah. Penelitian di Indonesia juga jarang sekali menggabungkan antara data administrasi, data geografis, dan data survei. Padahal, keberhasilan pembangunan infrastruktur berhubungan erat dengan sejumlah aspek dari *governance*, seperti perencanaan (Flyvbjerg, 2007), manajemen risiko (Ikediashi et al., 2014), dan faktor politis di wilayah tersebut (Bertelli et al., 2020; Wang et al., 2023), termasuk ketepatan alokasi anggaran infrastruktur publik (Huang et al., 2010).

Dalam RPJMN 2020-2024 (Indonesia, 2020), pembangunan infrastuktur merupakan salah satu dari lima arahan utama dalam strategi pencapaian misi Nawacita dan visi Indonesia Emas 2045. RPJMN menyebutkan bahwa pembangunan infrastruktur bertujuan untuk menghubungkan kawasan produksi dengan kawasan distribusi, mempermudah akses ke kawasan wisata, membuka lapangan kerja baru, dan mempercepat peningkatan nilai tambah perekonomian rakyat.

Dalam RPJMN 2020-2024, infrastruktur dibedakan menjadi tiga jenis, yaitu infrastruktur pelayanan dasar, infrastruktur ekonomi, dan infrastruktur perkotaan. World Bank (1994) menyebut infrastruktur ekonomi sebagai pembangunan fisik yang menunjang aktivitas ekonomi, meliputi *public utilities* (telekomunikasi, air bersih, sanitasi, gas), *public work* (jalan, bendungan, irigasi, drainase), dan sektor transportasi (jalan raya, rel kereta api, pelabuhan, lapangan terbang). Dalam rancangan RPJMN 2025-2029 yang disusun oleh Bappenas, salah satu isu strategis kewilayahan yang akan dievaluasi adalah terbatasnya kapasitas dan kualitas konektivitas antarwilayah dan infrastruktur dasar di Pulau Kalimantan (Kementerian PPN/Bappenas, 2023).

Penelitian ini bertujuan untuk mengevaluasi ketersediaan infrastruktur di Pulau Kalimantan, hubungan antara infrastruktur dengan kegiatan sosial ekonomi masyarakat, serta peran pemerintah melalui alokasi anggaran infrastruktur publik dalam meningkatkan ketersediaan infrastruktur di Kalimantan. Pulau tersebut dipilih sebagai

lokus penelitian karena pemerintah telah menetapkan bahwa ibu kota negara berpindah ke Pulau Kalimantan melalui Undang-undang Nomor 3 Tahun 2022. Oleh sebab itu, evaluasi terhadap ketersediaan infrastruktur di Kalimantan menjadi krusial dalam pengembangan wilayah tersebut sebagai ibu kota negara.

KERANGKA TEORI

Berbagai studi memperlihatkan pentingnya infrastruktur bagi perekonomian daerah. Wilayah dengan infrastruktur yang lebih baik, seperti keberadaan listrik, jalan, air bersih (Hapsari, 2011; Prasetyo & Firdaus, 2009), transportasi laut (Maryaningsih et al., 2014), dan penunjang komunikasi (Kusuma & Muta'ali, 2019; Lubis, 2017) cenderung memiliki tingkat pertumbuhan ekonomi daerah yang tinggi. Selain itu, infrastruktur memiliki keterkaitan dengan kesenjangan antarwilayah (Sukwika, 2018). Infrastruktur juga berkontribusi dalam meningkatkan sumber daya manusia. Studi di China (Zhao & Barakat, 2015), India (Joshi et al., 2023), dan Indonesia (Arifin, 2022; Yamauchi et al., 2011) menunjukan bahwa ketersediaan jalan dan jarak menuju fasilitas pendidikan dan kesehatan berkorelasi dengan peningkatan akses terhadap pendidikan dan kesehatan.

Meski demikian, kegagalan pembangunan infrastruktur juga kerap ditemui di berbagai negara, termasuk India (Reddy & Sharma, 2017), Saudi Arabia (Ikediashi et al., 2014), dan Indonesia (Wibowo & Alfen, 2015) karena buruknya manajemen risiko dari pemerintah dan/atau pihak swasta, kurangnya komunikasi, pembengkakan anggaran (Ikediashi et al., 2014), kekeliruan informasi tentang biaya dan manfaat dari infrastruktur terbangun (Flyvbjerg, 2007), serta adanya intervensi politik (Bertelli et al., 2020).

Adapun faktor-faktor yang mendukung kesuksesan pengembangan infrastruktur meliputi perencanaan yang matang, perbaikan tata kelola/*governance* (Flyvbjerg, 2007), ketersediaan sumber daya, kemitraan pemangku kepentingan utama, komunikasi, dukungan publik, dan kejelasan visi tentang pengembangan infrastruktur (Wang et al., 2023).

Hasil kajian terhadap kegagalan dan kesuksesan pengembangan infrastruktur menunjukkan bahwa peran lembaga eksekutif (Flyvbjerg, 2007; Wang et al., 2023) dan legislatif (Crain & Oakley, 1995) sangat krusial dalam mendorong investasi dan pengembangan infrastruktur di wilayah tersebut. Ketepatan perencanaan dan metode pemerintah dalam mengalokasikan anggaran infrastruktur publik (Huang et al., 2010) turut menentukan kesuksesan pengembangan infrastruktur melalui perkiraan biaya dan manfaat proyek, estimasi risiko, peningkatan akuntabilitas, serta kejelasan ruang lingkup dan tujuan (De Jong et al., 2013).

METODOLOGI

Penelitian ini memanfaatkan data anggaran serta *output* dan *outcome* dari beberapa sumber. Anggaran pemerintah pusat terkait infrastruktur konektivitas diperoleh dari aplikasi Sintesa Direktorat Jenderal Perbendaharaan (DJPB) tahun 2021-2023. Data tersebut dilengkapi dengan data Anggaran Pemerintah Daerah yang diperoleh dari Sistem Informasi Keuangan Daerah (SIKD) Direktorat Jenderal Perimbangan Keuangan (DJPK).

Data *output* terkait infrastruktur konektivitas didapatkan dari Badan Pusat Statistik (BPS), Kementerian/Lembaga terkait, serta data geospasial yang meliputi panjang jalan, jumlah jembatan, lokasi bandar udara, dan

pelabuhan yang tersedia untuk publik. Data ini didukung dengan data *output* terkait luas wilayah, jumlah dan tingkat kepadatan penduduk, serta peta wilayah.

Data *outcome* didapatkan dari data Potensi Desa (Podes) dan Survey Sosial Ekonomi Nasional (Susenas), antara lain rata-rata pendapatan/ konsumsi per kapita keluarga, jenis pekerjaan masyarakat, aktivitas ekonomi masyarakat (keberadaan warung, kedai, hotel, motel, bank, rumah sakit, fasilitas pendidikan), tingkat pendidikan, dan pelayanan kesehatan masyarakat.

Penelitian ini menggunakan pendekatan kuantitatif dengan deskripsi statistik anggaran terkait infrastruktur. Korelasi antara *output* dan *outcome* juga digunakan untuk melihat hubungan infrastruktur dengan aktivitas sosial ekonomi masyarakat. Evaluasi perbedaan rata-rata digunakan untuk mengetahui perbedaan aktivitas sosial ekonomi masyarakat di wilayah yang terdapat infrastruktur dengan wilayah sekitar.

Penelitian ini juga menggunakan analisis IRIO untuk melakukan simulasi hubungan anggaran dan kontribusi terhadap ekonomi wilayah secara keseluruhan. Tabel IRIO 2016 mencakup 34 provinsi di Indonesia dan 17 sektor. Penulis melakukan *shock* proyeksi anggaran tahun 2022-2023 pada sektor-sektor yang berhubungan dengan anggaran infrastruktur jalan.

Tantangan dalam memanfaatkan data dari berbagai sumber adalah perbedaan kodefikasi pada tiap jenis data yang meliputi perbedaan data wilayah dan kegiatan. Oleh sebab itu, kami melakukan penyeragaman kode data sintesa, SIKD, data *output,* dan data *outcome* dengan mengacu kepada kodefikasi wilayah BPS. Selain itu, kami melakukan penyeragaman kode kegiatan pada anggaran pemerintah pusat dan daerah untuk memungkinkan klasifikasi sesuai jenis infrastruktur konektivitas yang dianalisis. Kami juga melakukan penyeragaman nama variabel dari Podes dan Susenas karena adanya perbedaan nama variabel di setiap tahunnya.

Setelah menyeragamkan kode data, kami melakukan analisis hubungan antara anggaran, *output,* dan *outcome* untuk memahami keterkaitan antara ketiganya. Kami memanfaatkan data *Interregional Input Output* (IRIO) untuk memberikan simulasi dampak pemanfaatan anggaran jalan terhadap ekonomi di wilayah Kalimantan. Simulasi proyeksi anggaran perbaikan atau pembangunan jalan terhadap proyeksi Ekonomi (PDRB) di wilayah Kalimantan menggunakan Tabel *Interregional Input-Output* (IRIO) tahun 2016 yang dikeluarkan oleh BPS. Anggaran yang digunakan adalah anggaran yang diklasifikasikan untuk pembangunan jalan, baik dana anggaran pusat (APBN) maupun daerah (APBD). Simulasi dilakukan pada setiap provinsi di Kalimantan. Simulasi *shock* proyeksi anggaran jalan 2022-2023 diproyeksikan di Pulau Kalimantan, yaitu Kalimantan Selatan sebesar Rp2,14 triliun, Kalimantan Tengah Rp2,93 triliun, Kalimantan Barat Rp1,5 triliun, Kalimantan Timur Rp7,0 triliun, dan Kalimantan Utara Rp1.4 triliun.

HASIL DAN PEMBAHASAN

Pemerintah memiliki peran penting – selain juga pihak swasta – dalam pengembangan infrastruktur di berbagai wilayah di Indonesia, termasuk di Pulau Kalimantan. Pendanaan infrastruktur konektivitas pemerintah dapat berasal dari pemerintah pusat melalui Anggaran Pendapatan dan Belanja Negara (APBN) serta Anggaran Pendapatan dan Belanja Daerah (APBD). Bagian ini akan membahas perkembangan infrastruktur konektivitas serta hubungannya

dengan aktivitas sosial ekonomi masyarakat di Pulau Kalimantan.

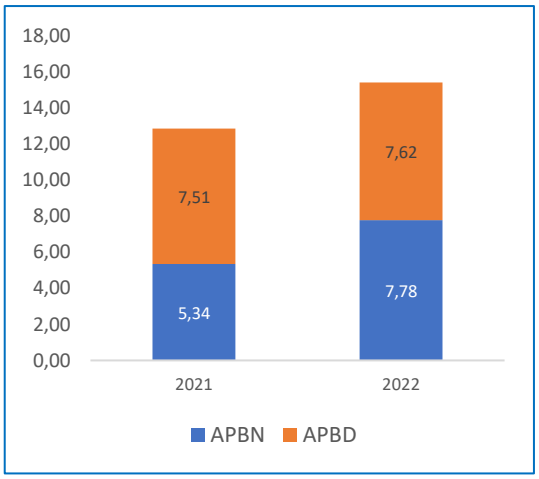
Infrastruktur konektivitas yang terdapat di Pulau Kalimantan meliputi jalan, jembatan, bandara, Pelabuhan, dan terminal. Salah satu aspek pembeda antara konektivitas di Kalimantan dengan di Jawa adalah tidak adanya infrastruktur berupa kereta api. Infrastruktur jalan merupakan sarana konektivitas yang paling banyak mendapat alokasi dana dari APBN atau APBD. Dengan luas wilayah daratan terbesar di Indonesia, jalan merupakan infrastruktur konektivitas paling utama dalam menunjang mobilitas masyarakat di Pulau Kalimantan.

Infrastruktur Jalan

Pembangunan infrastruktur konektivitas tidak akan berjalan optimal tanpa disertai dengan sumber pendanaan yang mencukupi. Pendanaan sarana infrastruktur dapat bersumber dari APBN/APBD sesuai dengan kewenangannya, seperti APBN untuk jalan nasional, bandara nasional, atau pelabuhan nasional, atau APBD untuk infrastruktur konektivitas yang menjadi kewenangan daerah (provinsi/kabupaten/kota).

Untuk Pulau Kalimantan, pemerintah pusat telah mengucurkan dana melalui APBN untuk berbagai jenis infrastruktur konektivitas kecuali kereta api yang sampai sekarang masih belum tersedia di pulau tersebut. Realisasi APBN untuk infrastruktur konektivitas nasional di Pulau Kalimantan dari tahun 2021-2023 adalah Rp38,3 triliun. Adapun kementerian/lembaga yang melaksanakan pembangunan infrastruktur tersebut adalah Kementerian Pekerjaan Umum dan Pemukiman Rakyat (Kemen-PUPR) sebesar Rp34,2 triliun dan Kementerian Perhubungan (Kemenhub) sebesar Rp4,1 triliun. Dilihat dari jenis ruang konektivitasnya, untuk darat mencapai Rp35,1 triliun, laut Rp1,3 triliun, dan udara Rp1,8 triliun. Sedangkan bila dilihat dari anggaran berdasarkan jenis kegiatan, jalan merupakan infrastruktur dengan realisasi anggaran terbesar sebesar Rp31,5 triliun, disusul dengan jembatan Rp2,6 triliun, dan bandara Rp1,5 triliun.

Gambar 1 memperlihatkan perkembangan anggaran jalan APBN dan APBD selama tahun 2021 dan 2022 di Pulau Kalimantan. Berdasarkan kewenangannya, jalan dibedakan menjadi tiga jenis: jalan nasional, jalan provinsi, dan jalan kabupaten/kota. Jalan nasional didanai dari APBN, jalan provinsi dari APBD provinsi, dan jalan kabupaten/kota dari APBD kabupaten/kota. Untuk jalan nasional, perkembangan realisasi anggaran selama tahun 2021-2021 mengalami kenaikan yang cukup signifikan. Realisasi anggaran jalan nasional setiap tahunnya mengalami perkembangan, dari Rp5,34 triliun pada tahun 2021 menjadi Rp7,78 triliun pada tahun 2022. Kenaikan signifikan ini dipicu adanya pembangunan infrastruktur jalan nasional di IKN yang cukup masif sejak tahun 2022.



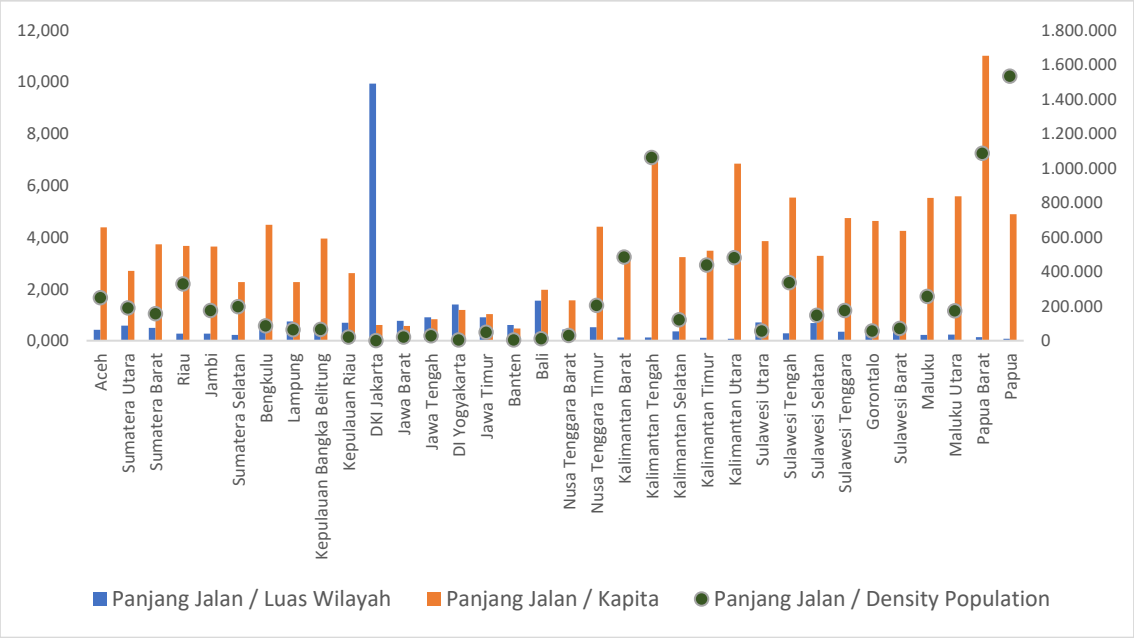
Gambar 1. Anggaran pemerintah pusat dan daerah terkait jalan (2021-2022)

Realisasi anggaran untuk jalan daerah yang danaannya bersumber dari APBD provinsi/ kabupaten/kota di Pulau kalimantan juga mengalami kenaikan, yaitu Rp7,51 triliun

pada tahun 2021 menjadi Rp7,62 triliun di tahun 2022. Peningkatan ini juga terjadi pada tahun-tahun sebelumnya. Anggaran yang terus bertambah mengindikasikan peran pemerintah dalam meningkatkan infrastruktur konektivitas di Kalimantan.

Dalam analisis tentang jalan terdapat beberapa terminologi yang sering digunakan, seperti panjang jalan, panjang jalan per luas wilayah (km), panjang jalan per kapita populasi penduduk, atau panjang jalan per kepadatan penduduk. Pemanfaatan panjang jalan tanpa distandarisasi terhadap luas wilayah, jumlah penduduk, atau kepadatan penduduk akan sensitif terhadap perbedaan geografi atau demografi di wilayah tersebut. Gambar 2 memberikan data panjang jalan per luas wilayah, panjang jalan per kapita dan panjang jalan per kepadatan penduduk untuk dapat melihat perkembangan jalan secara komprehensif di Kalimantan.

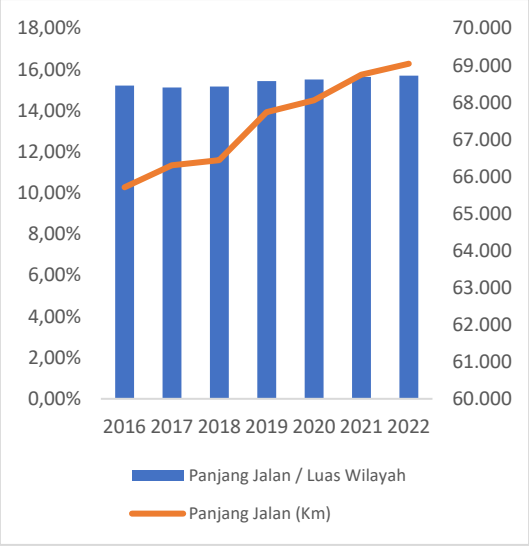
Gambar 2 di bawah mengindikasikan bahwa penggunaan panjang jalan per luas wilayah lebih bisa menggambarkan keadaan di Indonesia dibandingkan dengan penggunaan jumlah penduduk atau kepadatan penduduk. Sebagai contoh, jalan di Pulau Kalimantan dan Pulau Papua sering kali diindikasikan memiliki keadaan yang lebih baik dibandingkan di Pulau Jawa jika standar penilaiannya menggunakan panjang jalan per kapita atau panjang jalan per kepadatan penduduk *(population density)*. Namun, Pulau Kalimantan dan Pulau Papua diindikasikan masih tertinggal pada aspek infrastruktur jalan dibandingkan Pulau Jawa. Hal ini disebabkan karena besarnya wilayah di Pulau Kalimatan dan Pulau Papua serta populasi yang tersebar di berbagai wilayah di kedua pulau tersebut. Oleh sebab itu, analisis dalam penelitian ini menggunakan panjang jalan per luas wilayah.



Gambar 2. Alternatif analisis perkembangan jalan (2022)

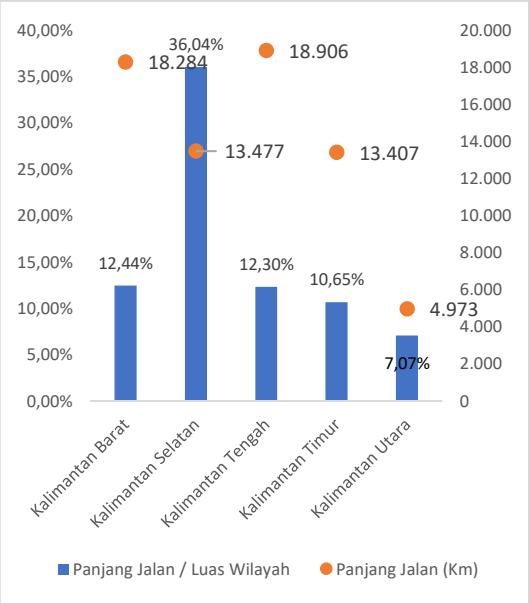
Gambar 3 memperlihatkan perkembangan jalan di Pulau Kalimantan selama periode 2016-2022. Gambar di atas mengindikasikan pembangunan jalan yang terbatas di Kalimantan walaupun terjadi peningkatan. Pada tahun 2016, rasio panjang jalan terhadap luas wilayah sebesar 15,22% dan meningkat menjadi 15,70% pada tahun 2022

(atau hanya meningkat sekitar 0,48% selama enam tahun). Akselerasi peningkatan akses jalan diperlukan untuk menunjang perkembangan sosial ekonomi inklusif, terlebih ibu kota negara akan berkedudukan di Kalimantan. Kemantapan jalan rata-rata di Kalimantan belum mencapai 80%. Hal ini menunjukkan capaian angka kemantapan jalan nasional di pulau tersebut masih berada di bawah rata-rata jalan mantap nasional seluruh provinsi di Indonesia.



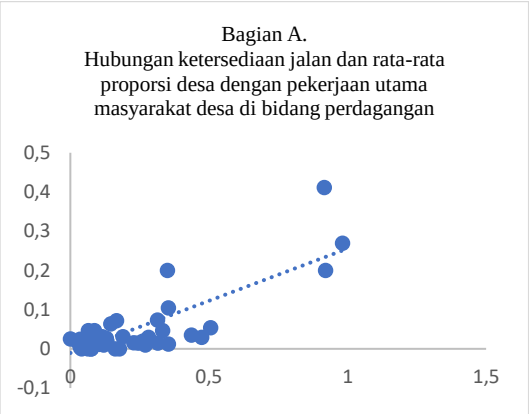
Gambar 3. Perkembangan jalan di Kalimantan (2016-2022)

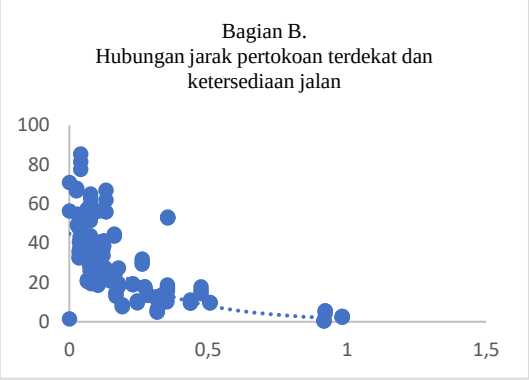
Selanjutnya, Gambar 4 di bawah ini menunjukkan masih besarnya proporsi wilayah yang belum terdapat akses jalan di Pulau Kalimantan terhadap luas wilayahnya. Kalimantan Selatan memiliki coverage jalan terbesar, yaitu sekitar 36% dari luas wilayah atau 13,5 ribu km. Namun, *coverage* jalan di Kalimantan Utara hanya 7% wilayah atau sekitar 4,9 ribu km. Sebagian besar proporsi pemanfaatan anggaran jalan di Kalimantan digunakan untuk perbaikan jalan daripada pembangunan jalan baru. Hal ini menunjukkan pentingnya alokasi dan pemanfaatan anggaran untuk pembangunan jalan baru, selain perbaikan rutin untuk meningkatkan akses jalan di pulau tersebut.

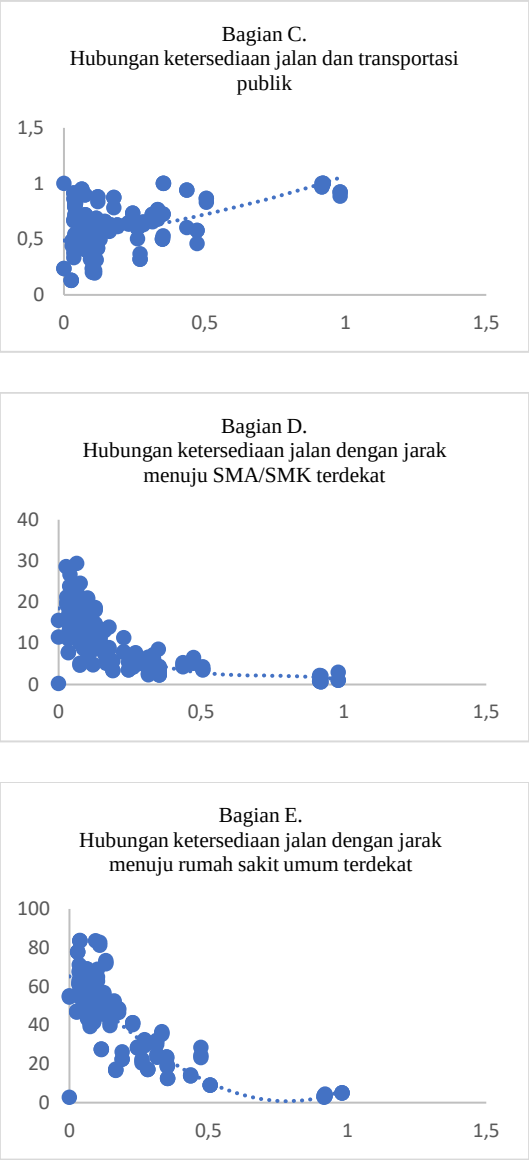


Gambar 4. Ketersediaan jalan antarwilayah di Kalimantan (2022)

Selanjutnya, Gambar 5 memuat lima bagian, yaitu bagian A-E. gambar-gambar tersebut memperlihatkan hubungan ketersediaan jalan dengan aktivitas sosial ekonomi masyarakat di Pulau Kalimantan.







Gambar 5. Hubungan ketersediaan jalan dengan aktivitas sosial ekonomi masyarakat (2021-2022)

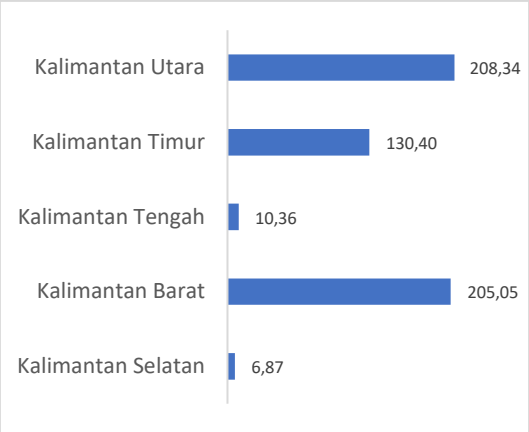
Bagian A menunjukkan hubungan rata-rata rasio panjang jalan per luas wilayah dengan rata-rata proporsi desa dengan pekerjaan utama masyarakat di bidang perdagangan pada tingkat kabupaten. Bagian B adalah rata-rata jarak menuju pertokoan terdekat. Bagian C adalah rata-rata proporsi desa yang memiliki transportasi publik. Bagian D adalah rata-rata jarak menuju SMA/SMK terdekat. Bagian E adalah rata-rata jarak menuju Rumah Sakit (RS) umum terdekat.

Kelima gambar di atas menunjukkan adanya hubungan antara peningkatan ketersediaan jalan per km^2 luas wilayah dengan meningkatnya aktivitas sosial ekonomi di Kalimantan. Wilayah (kabupaten) yang memiliki akses ketersediaan jalan berhubungan dengan meningkatnya aktivitas masyarakat di bidang perdagangan, berkurangnya jarak menuju pertokoan terdekat, serta meningkatnya ketersediaan transportasi publik. Sebagai contoh, rata-rata jarak menuju pertokoan di Kabupaten Mahakam Ulu mencapai 85 km dengan rata-rata jalan men-*cover* 4% wilayah tersebut.

Ketersediaan jalan juga berhubungan dengan akses terhadap fasilitas perkembangan sumber daya manusia. Kabupaten yang memiliki *coverage* jalan lebih besar berhubungan dengan lebih dekatnya akses menuju sarana pendidikan dan kesehatan di Kalimantan. Namun, hal ini juga mengindikasikan masih terdapat wilayah di Kalimantan yang jarak tempuh sangat panjang menuju sarana pendidikan, seperti terdapat 11 kabupaten dengan rata-rata jarak tempuh ke SMA/SMK terdekat lebih dari 20 km pada tahun 2021.

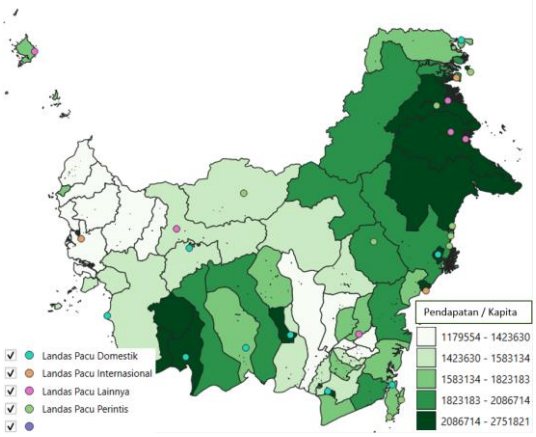
Infrastruktur Bandar Udara *(Airport)*

Terdapat setidaknya 54 bandara di Pulau Kalimantan pada tahun 2023 dengan sebaran 12 bandara di Provinsi Kalimantan Barat, 12 bandara di Kalimantan Tengah, 4 bandara di Kalimantan Selatan, 13 bandara Kalimantan Timur, dan 13 bandara Kalimantan Utara. Berbeda dengan pendanaan untuk jalan, seluruh pendanaan bandara di Kalimantan bersumber dari pemerintah pusat (dalam hal ini dilaksanakan oleh Kementerian Perhubungan). Selama tahun 2021-2022, pendanaan untuk bandara adalah Rp1,022 triliun. Realisasi APBN untuk bandara di Kalimantan sebesar Rp673 miliar pada 2021 dan turun menjadi Rp349 miliar pada 2022.



Gambar 6. Anggaran pemerintah pusat terkait bandara (2022, miliar rupiah)

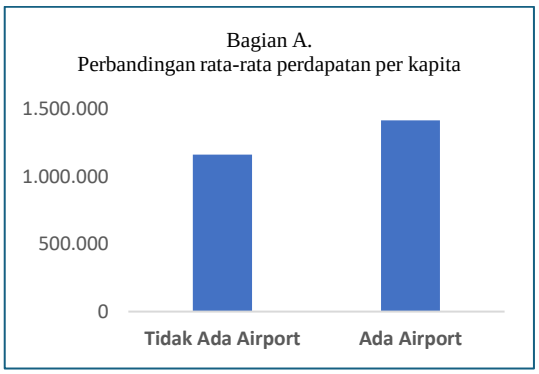
Gambar 6 menunjukkan APBN terkait bandara untuk setiap provinsi di Pulau Kalimantan pada tahun 2022. Realisasi tertinggi untuk anggaran bandara dari APBN berada di Kalimantan Utara sebesar Rp208 miliar, diikuti Kalimantan Barat Rp205 miliar, Kalimantan Timur Rp130 miliar, Kalimantan Tengah 10 miliar, dan terakhir Kalimantan Selatan Rp7 miliar.

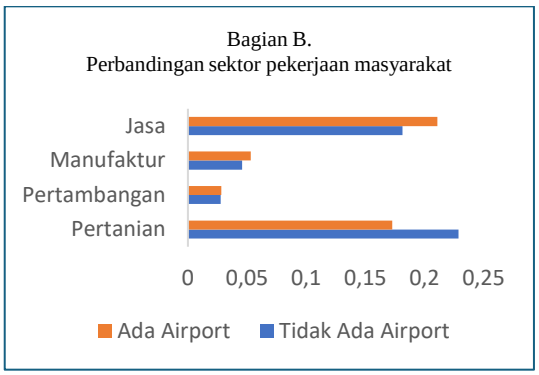


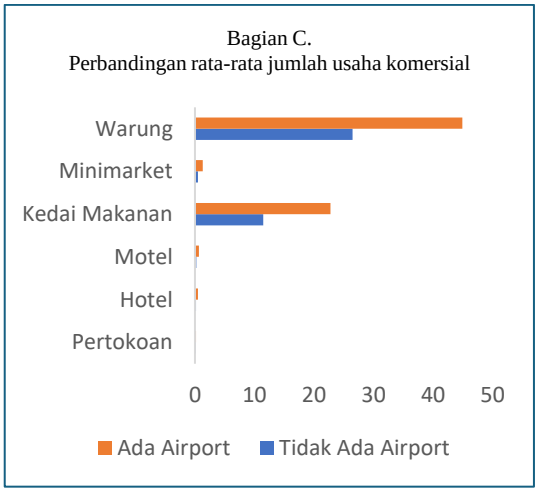
Gambar 7. Distribusi bandara dan pendapatan/ pengeluaran per kapita masyarakat (2022)

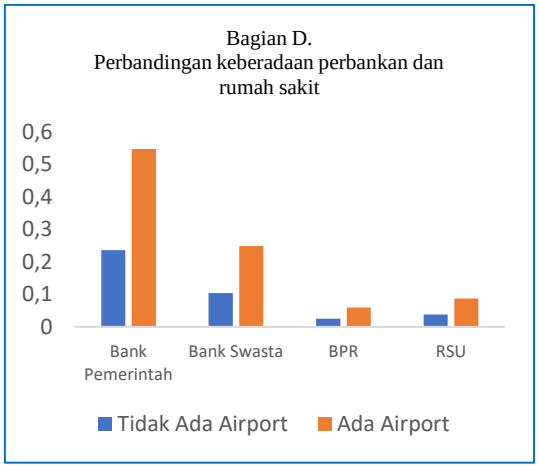
Gambar 7 memperlihatkan distribusi bandara dan pendapatan/konsumsi per kapita masyarakat di Kalimantan. Bandara terdistribusi di seluruh provinsi di pulau tersebut. Namun, terdapat kabupaten tertentu yang memiliki manfaat lebih karena adanya keberadaan bandara di wilayahnya. Masyarakat yang tinggal di kabupaten yang terdapat bandara memiliki pendapatan per kapita sekitar 21,87% lebih tinggi dibandingkan dengan masyarakat yang tinggal bukan di wilayah yang terdapat bandara (Gambar 8 bagian A).

Gambar 8 bagian B-D menampilkan estimasi aktivitas sosial ekonomi masyarakat di wilayah dengan adanya bandara dan wilayah tanpa bandara untuk dapat memahami perbedaan potensi dari kedua wilayah.







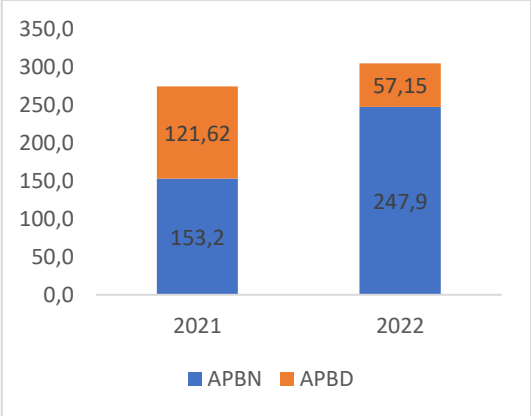


Gambar 8. Estimasi perbedaan pendapatan / pengeluaran per kapita dan aktivitas sosial ekonomi masyarakat – Bandara (2021-2022)

Kebanyakan masyarakat yang bertempat tinggal di wilayah terdapat bandara bekerja di bidang jasa dan manufaktur dibandingkan dengan mereka yang tidak tinggal di wilayah bandara. Namun, masyarakat yang bekerja di sektor pertanian cenderung lebih sedikit yang tinggal di wilayah terdapat bandara. Usaha-usaha komersial berkembang lebih besar di wilayah yang terdapat bandara, seperti warung, minimarket, kedai makanan, hotel, motel, dan pertokoan. Begitu pula keberadaan institusi keuangan dan kesehatan yang cenderung lebih banyak terdapat di wilayah yang terdapat bandara. Hal ini mengindikasikan lebih dekatnya akses masyarakat sekitar wilayah bandara terhadap lembaga keuangan dan fasilitas kesehatan.

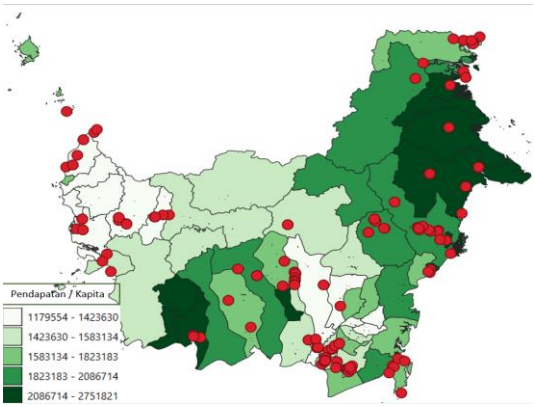
Infrastruktur Pelabuhan

Di negara kepulauan yang memiliki banyak daerah perairan seperti sungai, pelabuhan memiliki peran penting dalam konektivitas di Pulau Kalimantan terutama di Kalimantan Selatan, Kalimantan Timur, dan Kalimantan Utara. Dukungan pemerintah untuk meningkatkan ketersediaan pelabuhan adalah dalam bentuk penyediaan APBN. Selama kurun waktu 2021-2022, realisasi anggaran pelabuhan sebesar Rp401 miliar yang semuanya bersumber dari Kementerian Perhubungan. Setiap tahunnya, realisasi pelabuhan dari APBN mengalami kenaikan, yaitu sebesar Rp153 miliar pada tahun 2021 menjadi Rp247 miliar pada tahun 2022.



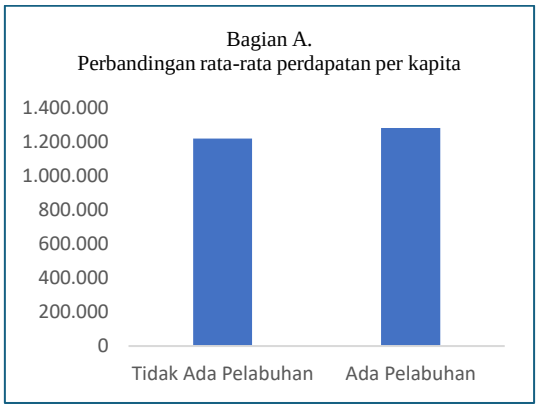
Gambar 9. Anggaran pemerintah pusat dan daerah terkait pelabuhan (2021-2022, miliar rupiah)

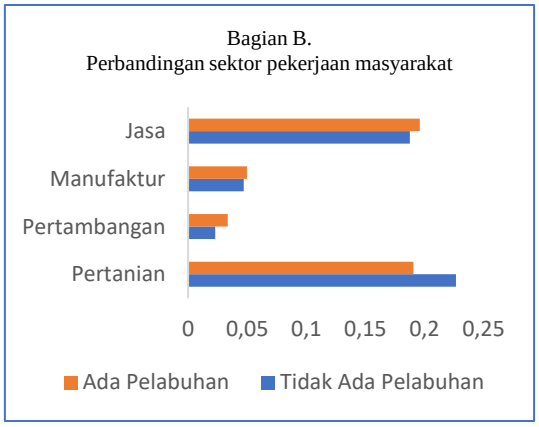
Selain itu, dukungan anggaran pelabuhan juga bersumber dari APBD di Kalimantan. Realisasi anggaran terkait pelabuhan diperkirakan sebesar Rp121 miliar pada 2021 dan Rp57 miliar pada 2022. Realisasi tertinggi pada tahun 2022 adalah di Provinsi Kalimantan Timur Rp18 miliar, Kalimantan Barat Rp16 miliar, Kalimantan Tengah Rp11 miliar, Kalimantan Selatan Rp6 miliar, dan Kalimantan Utara Rp6 miliar.

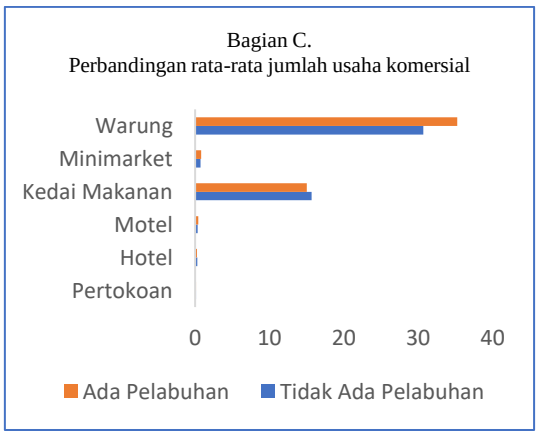


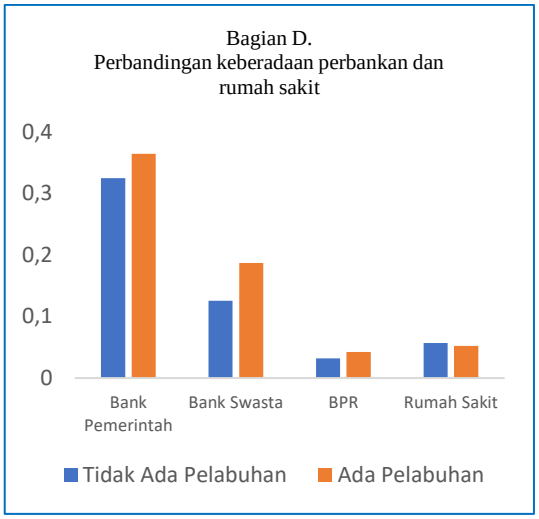
Gambar 10. Distribusi pelabuhan dan pendapatan / pengeluaran per kapita masyarakat (2022)

Gambar 10 di bawah ini menunjukkan bahwa pelabuhan terdistribusi di seluruh provinsi di Kalimantan, namun kabupaten tertentu memiliki manfaat lebih karena adanya keberadaan pelabuhan di wilayahnya. Masyarakat yang tinggal di Kabupaten terdapat pelabuhan memiliki pendapatan per kapita relatif 5,04% lebih tinggi dibandingkan dengan masyarakat yang tinggal bukan di wilayah yang terdapat pelabuhan (Gambar 11 bagian A).









Gambar 11. Estimasi perbedaan pendapatan / pengeluaran per kapita dan aktivitas sosial ekonomi masyarakat – Pelabuhan (2021-2022)

Masyarakat yang bertempat tinggal di wilayah terdapat pelabuhan memiliki kecenderungan untuk bekerja di bidang pertambangan, jasa, dan manufaktur dibandingkan masyarakat yang tidak terdapat pelabuhan di wilayah tersebut. Masyarakat yang bekerja di sektor pertanian cenderung lebih sedikit yang tinggal di wilayah terdapat pelabuhan. Selain itu, usaha-usaha komersial berkembang lebih besar di wilayah yang terdapat Pelabuhan, yaitu berupa warung masyarakat. Begitupun keberadaan institusi keuangan. Namun, akses kesehatan relatif setara. Hal ini mengindikasikan pelabuhan terkait dengan pertambangan, namun proporsi pekerja pertambangan relatif kecil sehingga meningkatkan sebagian pendapatan warga di wilayah tersebut.

Simulasi Anggaran Infrastruktur Jalan terhadap Kontribusi Ekonomi Kalimantan

Simulasi proyeksi anggaran perbaikan/ pembangunan jalan terhadap proyeksi Ekonomi (PDRB) di wilayah Kalimantan menggunakan Tabel *Interregional Input-Output* (IRIO) tahun 2016 yang dikeluarkan oleh BPS. Anggaran yang digunakan adalah

anggaran yang diklasifikasikan untuk pembangunan jalan, baik menggunakan dana APBN maupun APBD. Simulasi dilakukan pada setiap provinsi di Pulau Kalimantan. Simulasi *shock* anggaran jalan tahun 2022-2023 diproyeksikan di Kalimantan Selatan sebesar Rp2,14 triliun; Kalimantan Tengah Rp2,93 triliun; Kalimantan Barat Rp1,5 triliun; Kalimantan Timur Rp7,0 triliun, dan Kalimantan Utara Rp1,4 triliun. Hasil simulasi mengindikasikan bahwa anggaran perbaikan/pembangunan jalan di Kalimantan berkontribusi terhadap sektor dan provinsi utama, yaitu antara 0,9% PDRB hingga 1,8% PDRB di provinsi utama di Pulau Kalimantan, serta terhadap wilayah lain di luar wilayah utama.

SIMPULAN DAN SARAN

Infrastruktur konektivitas memiliki peran penting terhadap perkembangan sosial ekonomi di Pulau Kalimantan. Pemerintah berperan melalui penyediaan anggaran infrastruktur konektivitas, terutama jalan, bandara, dan pelabuhan.

Coverage infrastruktur jalan di Kalimantan masih terbatas antara 7% (Kalimantan Utara) hingga 36% (Kalimantan Selatan). Perkembangan pembangunan jalan baru juga sangat terbatas. Hal ini berhubungan dengan anggaran yang terus meningkat namun lebih banyak digunakan proporsinya untuk pemeliharaan rutin daripada pembangunan jalan baru di Kalimantan.

Keberadaan infrastruktur jalan yang berkorelasi positif dengan peningkatan kegiatan ekonomi masyarakat dan akses sumber daya manusia (pada pendidikan dan kesehatan) mengindikasikan bahwa peningkatan *coverage* jalan sangat diperlukan melalui pembangunan jalan-jalan baru.

Kebijakan peningkatan pembangunan jalan baru terutama di wilayah Kalimantan Utara dapat dilakukan melalui alokasi transfer ke daerah yang di *earmark* anggaran infrastruktur (Contoh: DAK Fisik) lainnya bagi pembangunan jalan. Selain itu, monitoring dan evaluasi berkelanjutan pada perkembangan jalan sebagai sarana evaluasi alokasi anggaran juga perlu dilakukan.

Keberadaan bandara dan pelabuhan berkorelasi positif dengan perkembangan aktivitas ekonomi masyarakat, terutama peningkatan usaha retail seperti warung, kedai makanan, dan penginapan. Akses terhadap literasi wiraswasta serta akses terhadap pembiayaan diharapkan dapat membantu meningkatkan aktivitas ekonomi di daerah tersebut. Koordinasi pemerintah daerah dan instansi pusat memiliki peran penting suksesnya upaya peningkatan dan monitoring infrastruktur konektivitas di Pulau Kalimantan.

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Exploring Risk Aspects in Public-Private Partnership Infrastructure Research: A Bibliometric Analysis

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ABSTRACT

The risk aspect is a key component of the Public-Private Partnership (PPP) infrastructure scheme. The study employed bibliometric analysis to shed light on research trends concerning risk aspects in PPP. The author focused on publication trends, co-authorship networks, local citation patterns, cluster analysis, and co-occurrence of key terms. In addition, the authors compiled a list of studies on the risk aspects of PPP infrastructure. Using bibliometric data from 356 Scopus-indexed publications, this study identifies the leading authors, nations, institutions, publishers, influential papers, and research topics related PPP infrastructure risk over the past decade (2014-2023). The findings reveal that from 2014 to 2017, research predominantly focused on risk factors, success criteria, development projects, contracts, toll roads, water supply, and social infrastructure. Between 2018 and 2020, the emphasis shifted towards risk assessment, risk analysis, risk management, and risk allocation. Since 2021, the research trends have evolved to include urban growth, investment, the private sector, partnership models, internet protocols, and intelligent systems. Future research on PPP infrastructure risk should incorporate technological concepts and business entity perspectives. This study also contextualizes its findings within the broader landscape of emerging markets in Asia and globally and highlights these trends in the Indonesian context.

Keywords: Bibliometric analysis; Infrastructure; PPP; Risk aspects

ABSTRAK

Aspek risiko merupakan elemen penting dalam skema KPBU infrastruktur. Penelitian ini mencoba menginventarisasi kajian-kajian mengenai aspek risiko infrastruktur KPBU melalui analisis bibliometrik. Peneliti berfokus pada tren publikasi, *co-authorship*, pola kutipan (lokal), analisis klaster, dan penggunaan istilah-istilah kunci dari 356 artikel terindeksasi Scopus. Peneliti mengidentifikasi para penulis, negara, institusi, penerbit, artikel, dan topik penelitian terkemuka mengenai aspek risiko infrastruktur KPBU dalam satu dekade terakhir (2014-2023). Temuan penelitian ini menunjukkan bahwa sejak tahun 2014 hingga 2017 sebagian besar kajian berfokus pada faktor risiko, kriteria keberhasilan, proyek pembangunan, kontrak, jalan tol, pasokan air, dan infrastruktur sosial. Antara tahun 2018 dan 2020 penelitian banyak mengkaji penilaian risiko, analisis risiko, manajemen risiko, dan alokasi risiko. Sejak 2021, tren penelitan bergeser pada pertumbuhan perkotaan, investasi, sektor swasta, model kemitraan, *internet protocol*, dan sistem cerdas. Penelitian terkait risiko ke depan sebaiknya memiliki pembaharuan dengan memasukkan konsep teknologi dan sudut pandang badan usaha dalam kerangka skema infrastruktur KPBU. Penelitian ini juga mengkontekstualisasi temuan dengan lanskap yang lebih luas di pasar-pasar baru Asia dan dunia sebagai bahan perbandingan dengan tren penelitian di Indonesia.

Kata Kunci: Aspek-aspek risiko; Bibliometrik; Infrastruktur; KPBU

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INTRODUCTION

In recent decades, risk has been an important feature of research in Public-Private Partnership (PPP) infrastructure. It has transformed into a more attractive and most-researched topic worldwide. Some studies suggest that the benefits of risk aspects include enhancing the recovery rate for lenders and their predicted loss (Zapata Quimbayo & Mejía Vega, 2023), monitoring the schedule of construction phase (Akhtar et al., 2023; Putri et al., 2023), and managing the smooth implementation of PPP projects (Chen et al., 2023; Chiang et al., 2022; Feng et al., 2021; Moradi Shahdadi et al., 2023). Other relevant research elucidates prominent positive views as studying the risk of PPP to become the key factor of PPP's success (Fathi & Shrestha, 2023; Lima et al., 2023; Ramli et al., 2021), enhance the resilience of PPP (Li & Wang, 2023), investigate common risk allocation in middle-income nations vs. low-income ones (Kouton et al., 2023), evaluate PPP projects (Jokar et al., 2023), attract business environment (Belghiti & Angade, 2023; Tamošaitienė et al., 2021), and promote sustainable infrastructure development (Braeckman et al., 2022; Khahro et al., 2021; Mazher et al., 2022).

In addition to the mentioned benefits, some scholars share similar notions regarding the benefits of risk aspects such as making decisions on PPP project investments (Amiri et al., 2022; Dorfeshan et al., 2022; Fan et al., 2022; Geng et al., 2022; Sumrit, 2021; Sun et al., 2023), providing technical, guide, and reference support (Hartono et al., 2021; Zhai et al., 2021; Zhang et al., 2021; Zhang et al., 2021), achieving smooth transfer phase (Bao et al., 2022), reaping financial and operating benefits (Sidorenko et al., 2021) and improving project resilience (Liyanage & Villalba-Romero, 2021).

This research attempts to complement previous studies concerning the topic of risk aspects in the PPP scheme by mapping its trend using bibliometric techniques. The articles included in this study were generated from reputable articles indexed by Scopus with a more recent year range, from 2014 to 2023. The research findings are expected to inspire the development of the risk aspects in the PPP-related studies and see whether Indonesia (both in terms of researchers, research topics, organizations, and sponsors) is included in the top ranks of research. The perspective employed in this study helps to set the groundwork for PPP infrastructure by understanding the present risk component as extracted from innovative studies in the literature.

This study tries to highlight grey areas that demand quick attention from professionals by categorizing blank lines that influence risk characteristics contributing to the

formulation of PPP infrastructure policies. This study may help to generate guidance for practitioners by incorporating characteristics of several studies that affect PPP infrastructure risks. Finally, the study employs rigorous scientific approaches to investigate the prevalent research trends linked to PPP infrastructure risk, thereby providing fresh references for future research and identifying an emerging research agenda for PPP infrastructure risk.

To meet the research aims, this study employed bibliometric analysis, i.e., an assessment of the bibliographic information of published scientific materials by statistical techniques following qualitative and quantitative indices that combine bibliographic mapping, publication profiling, clustering, and visualizing (Ali et al., 2023; Donthu et al., 2021; Kumar et al., 2021; Sholihin et al., 2021).

THEORETICAL FRAMEWORK

Public-Private Partnership (PPP) is one of many options for financing public infrastructure development. PPPs have broadened the restricted list of public project financing options available to the authorities, due in part to their low-cost encouragement of economic development and social welfare optimization. PPPs are based on the idea that the private industry, with its advanced technological and management abilities, is better capable of producing higher-quality products than the government (Chen et al., 2023; Chiang et al., 2022; Feng et al., 2021; Kouton et al., 2023; Moradi Shahdadi et al., 2023).

Generally, risks associated with PPP projects will be recognized, exchanged, and negotiated throughout the contract-making cycle. In the context of future collaboration, the joint structuring of contract components, including sharing of risk, reward delivery, and execution of projects between both the public and the private industry, is a transparent form (Chen et al., 2023; Fathi & Shrestha, 2023; Lima et al., 2023; Ramli et al., 2021; Sunandar & Indiyati, 2023).

Risk, as its name suggests, refers to a state of uncertainty and, unfortunately, the majority of risks will often result in unintended losses. Risk analysis is essential for a company to minimize losses. Risk analysis seeks to detect the likelihood of a firm's profit or loss. Construction, operation, finance, trade, and politics are common categories of risks. Financial risks arise due to inaccurate assumptions about the rates of inflation, interest fluctuation, and currencies. Construction risks include unanticipated and unplanned delays and expenditures. Meanwhile, operational risk is an accident and vandalism that produces damages. Commercial hazards arise as a result of incorrect cost or traffic volume projections (Lima et al., 2023; Putri et al., 2023).

PPP projects are risky because of the large number of participating parties, the long agreement period, and the intricacies of legal contracts. Recent research on PPP projects focuses on identifying risks, assessments, and allocation (Sun et al., 2023). In terms of risk identification, various scholars have conducted research on the risks of PPP (Fathi & Shrestha, 2023; Li & Wang, 2023; Moradi Shahdadi et al., 2023; Pai et al., 2018; Shams Eldin et al., 2019; Sun et al., 2023). Regarding assessment of risk, the proposed risk analysis framework is based on criteria for assessment and relevant project knowledge to assess all of the risk (Ameyaw & Chan, 2015; Ameyaw & Chan, 2015; Belghiti & Angade, 2023; Chen et al., 2023; Nguyen et al., 2018; Sun et al., 2023; Tamošaitienė et al., 2021).

Risk allocation is a primary concern among risk-reduction actors: government agency, business industry, or a combination of both. Risk must be allocated to the appropriate parties, who may determine the likelihood of risk, manage the consequences of risk occurrence, and bear the risk at the lowest risk cost. Risks in critical categories or levels must be addressed by the appropriate parties to ensure that risk management runs as needed (Jokar et al., 2023; Kouton et al., 2023; Putri et al., 2023; Selim et al., 2019).

The theoretical framework of the risk aspects in the PPP process is summarized in Figure 1.

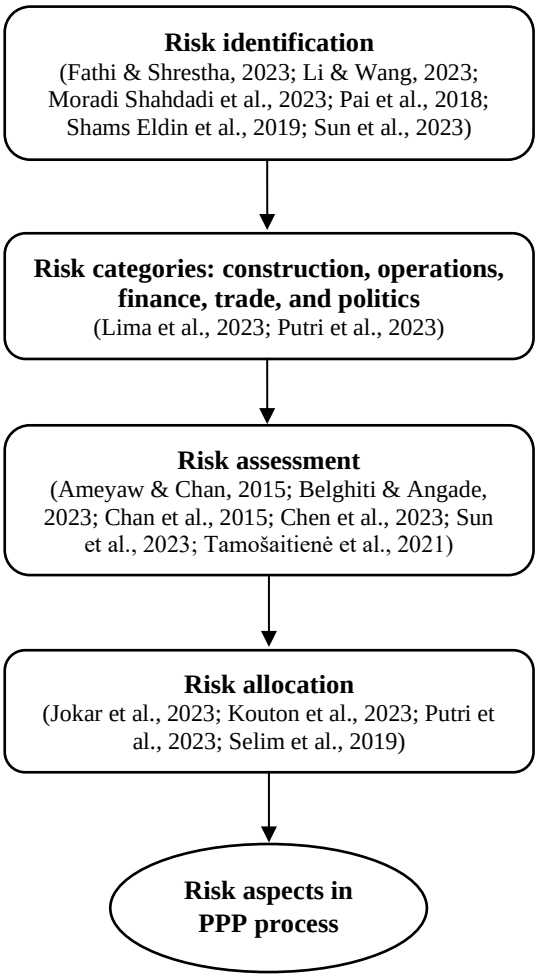

Figure 1. Theoretical framework
Source: Author's figure (2024)

METHODOLOGY

To achieve the objectives, the authors use a bibliometric analysis technique to determine the best-suited research themes regarding the risk aspects of PPP infrastructure. In the last decade, this study complements risk aspects of the PPP scheme by mapping its development using bibliometric techniques by focusing on reputable articles indexed by Scopus between 2014 and 2023. We expect that we can understand the development of the research focus on risk aspects in the PPP scheme and see whether Indonesia (both in terms of researchers, research topics, organizations, and research sponsors) is included in the top ranks of research. This assumption is supported by conducting a Scopus search for "risk PPP infrastructure" between 2014 and 2023. The authors' institutional subscription allowed them to access the study contents. Journals indexed by Scopus are mostly reputable because those listed in this database must adhere to strict indexing requirements and it is frequently suggested for bibliometric analysis.

Figure 1 illustrates the three-phase process of selecting studies for bibliometric analysis. The first phase was an indexing search that began in early May 2024 to prioritize all possible Scopus papers issued between 2014 and 2023 that contained "risk PPP infrastructure" keywords in the article's title or abstract. The phase generated 579 results. Then, the authors decided on and confirmed the phrases used to find papers relevant to this study. The second phase was filtration, in which papers were included for bibliometric analysis. The authors selected published articles rigorously by journals and preserved articles based on the English language because some studies were published in languages other than English, which hindered the authors from reviewing big data sets. As a result, 223 articles were

eliminated and 356 articles were kept. The 356 articles were screened for bibliometric review in the third phase of this search technique. The finalized papers were processed for bibliometric analysis, which was discussed in sections 4 and 5.

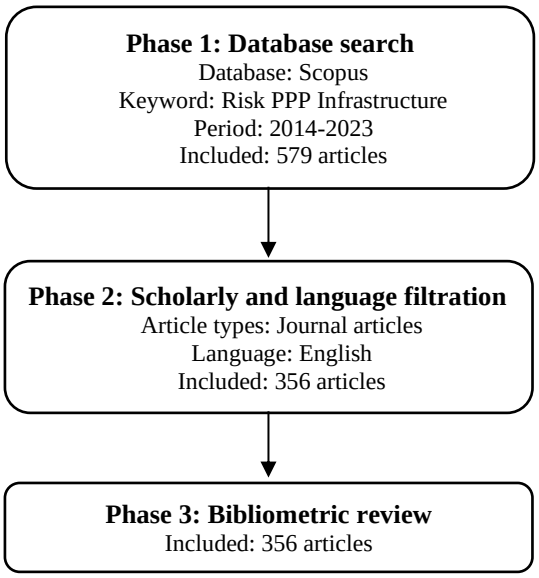

Figure 2. Bibliometric review approach
Source: Author's creation (2024)

Figure 2 explains the evaluation carried out in bibliometric analysis of the risk aspects in PPP infrastructure literature. The 356 shortlisted articles (retrieved from Scopus) were subjected to different bibliometric studies. Scholars were particularly interested in undertaking publishing, global citation, and cluster analyses to investigate publication trends, top contributors (authors, institutional affiliations, and nations), and main publishers (outlets and publications) of PPP infrastructure risk.

FINDINGS

The authors formulated and discussed the findings concerning bibliometric features and research themes by linking them with the risk components of PPP infrastructure research.

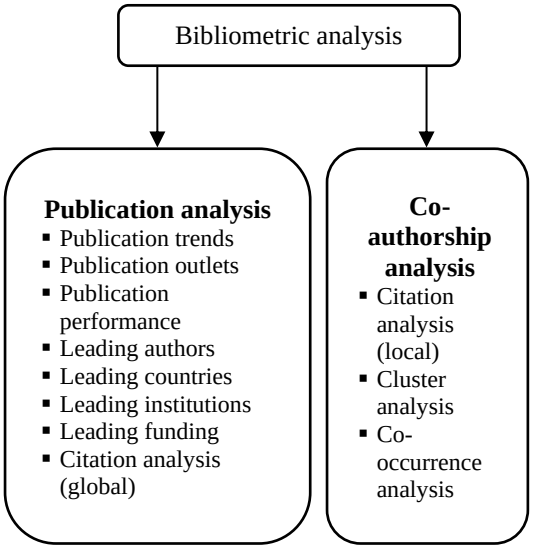

Figure 3. Bibliometric review analysis strategy
Source: Author's creation (2024)

Publication Trend

The allocation of papers by their year of publication implies that the risk factor in PPP infrastructure has experienced a surge in scholarly interest during the previous decade (see Figure 3). The majority of research was published in 2019 (n=53). Interestingly, the risk factors in PPP infrastructure research increased by double digits every year from 2014 to 2023, which can be linked to the expansion of accelerated infrastructure development in many nations during the last decade.

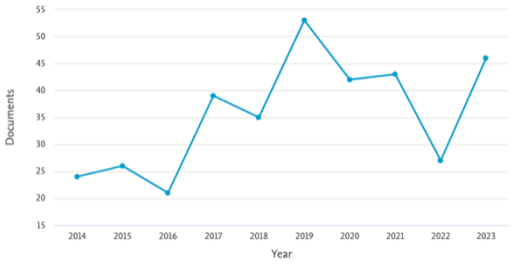

Figure 4. Research publication trend from 2014 to 2023
Source: Authors' creation (2024)

Publication Outlet

The allocation of publications by publication outlets demonstrates that the *Journal of Construction Engineering and Management* is an especially productive source for risk aspects in PPP infrastructure research (n=14) (see Table 1). *Sustainability*, *Journal of Management in Engineering*, and *Management Journal of Infrastructure Systems* follow the trend, with 13, 9, and 8 articles on risks in PPP infrastructure research, respectively. The majority of publication sources on this list are journals classified in the Q1 journal impact quartile by SJR, indicating that the risk factors of PPP infrastructure research are valued at top-tier journals.

Table 1. Top journals contributing to the research
Source: Authors' creation (2024)

Journal title	No. of articles	Journal impact quartile
Journal of Construction Engineering and Management	14	Q1
Sustainability	13	Q1
Journal of Management in Engineering	9	Q1
Journal of Infrastructure Systems	8	Q2
Built Environment Project and Asset Management	7	Q1
International Journal of Project Management	7	Q1
Construction Management and Economics	6	Q1
Engineering Construction and Architectural Management	6	Q1
International Journal of Civil Engineering and Technology	6	-
International Journal of Strategic Property Management	6	Q3

Global Citations

Global citations are the total amount of citations acquired without any filtering (for example, by discipline). In this analysis, the paper with the highest global citations is "Public-private partnership in public administration discipline: A literature review" (n=272 citations), followed by "Cross-country comparisons of key drivers, critical success factors, and risk allocation for public-private partnership projects" (n=222 citations) (see Table 2).

Table 2. Top ten papers with the most global citations according to Scopus
Source: Authors' creation (2024)

Rank	Article title	Author (Year)	Citation
1	Public-private partnership in public administration discipline: A literature review	Wang et al. (2018)	272
2	Cross-country comparisons of key drivers, critical success factors, and risk allocation for public-private partnership projects	Chou & Pramudawardhani (2015)	222
3	Evaluation and ranking of risk factors in public-private partnership water supply projects in developing countries using fuzzy synthetic evaluation approach	Ameyaw & Chan (2015)	185
4	Concession period for PPPs: A win-win model for a fair risk-sharing	Carbonara et al. (2014)	146

Rank	Article title	Author (Year)	Citation
5	Conceptual framework for the performance measurement of public-private partnerships	Liu et al. (2015)	119
6	Cross-sectional analysis of critical risk factors for PPP water projects in China	Chan et al. (2015)	116
7	Financial risk assessment and modeling of PPP-based Indian highway infrastructure projects	Kumar et al. (2018)	109
8	Bibliometric Analysis of PPP and PFI literature: Overview of 25 years of research	De Castro E Silva Neto et al. (2016)	98
9	Critical risk factors affecting the implementation of PPP waste-to-energy projects in China	Xu et al. (2015)	93
10	Risk ranking and analysis in PPP water supply infrastructure projects	E. E. Ameyaw & A. P. Chan (2015)	91

Leading Authors

The ranking of publications by authors reveals that Chan, A. P. C. from the Hong Kong Polytechnic University, Hong Kong, and Ameyaw, E. E. from the University of Northumbria, Newcastle, UK have published the most articles on the risk components of PPP infrastructure (n=6 articles) (see Table 3). The authors who contributed the second and third most publications on the risk component of PPP infrastructure are Marques, R. C. (n=5 articles), and Xiong, W. and Liu, J. (n=4 articles), respectively.

Table 3. Top contributing authors to the research
Source: Authors' creation (2024)

Author	Affiliation	Number of articles
Chan, A. P. C.	The Hong Kong Polytechnic University, Hong Kong	6
Ameyaw, E. E.	University of Northumbria, Newcastle, United Kingdom	6
Marques, R. C.	Lusófona University, Lisbon, Portugal	5
Xiong, W.	Tongji University, Shanghai, China	4
Liu, J.	Southwest Jiaotong University, Chengdu, China	4
Osei-Kyei, R.	Western Sydney University, Penrith, Australia	3
Aminnejad, B.	Islamic Azad University, Tehran, Iran	3
Bilal, M.	Atlantic Technological University, Killybegs, Ireland	3
Chan, D. W. M.	The Hong Kong Polytechnic University, Hong Kong	3
Jagboro, G. O.	Obafemi Awolowo University, Ife, Nigeria	3

Leading Countries

The ranking of papers by country indicates that authors from 68 countries contributed and published studies on the risk aspects of PPP infrastructure. According to the country-by-country analysis, China

contributes the most to research (72 articles), followed by Australia (43 articles), the United States (36 articles), and the United Kingdom (30 items). In Asia, behind China, India is the second largest contributor to research (29 papers), followed by Hong Kong (19 articles), Iran (13 articles), and Malaysia (13 articles) (See Figure 4).

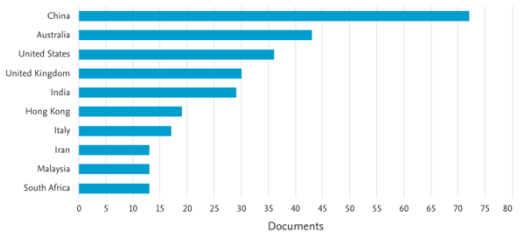

Figure 5. Top 10 leading countries
Source: Authors' creation (2024)

Institutions

The distribution of articles by institution shows that the Hong Kong Polytechnic University in Hong Kong is the leading university contributing to the risk aspects of PPP infrastructure focus (n=16) (see Figure 5). The table also includes Instituto Superior Técnico and Universidade de Lisboa in Portugal (n=8 articles), the University of Johannesburg in South Africa, Dalian University of Technology and Tongji University in China, and Obafemi Awolowo University in Nigeria; each of which contributes 7 articles.

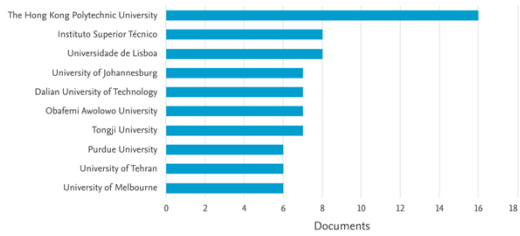

Figure 6. Top 10 leading institutions
Source: Authors' creation (2024)

Leading Funding Sponsor

The distribution of publications by funding sponsor shows that the National Natural Science Foundation of China is the leading and generous sponsor for risk-related PPP infrastructure research (32 articles) (see Figure 6). This is followed by Fundamental Research Funds for Central Universities (10 articles), European Regional Development Fund, and Hong Kong Polytechnic University; each has 5 articles.

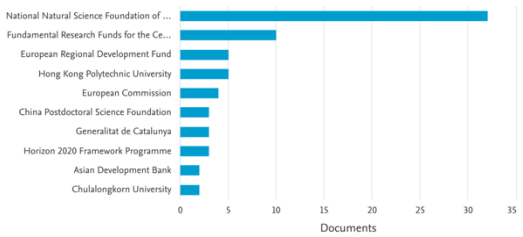

Figure 7. Top 10 leading funding sponsor
Source: Authors' creation (2024)

Topics or Themes

A co-occurrence study was conducted using every keyword from 356 articles in VOSviewer to uncover the subjects that can reflect a desire for the risk aspects of PPP infrastructure studies (see Figure 7). In this concept, keywords represent the article's focus. More importantly, the co-occurrence of keywords is important in the development of knowledge as a domain's intellectual framework, specifically the subjects in the intellectual structure of risks in PPP infrastructure as viewed through a regular lens.

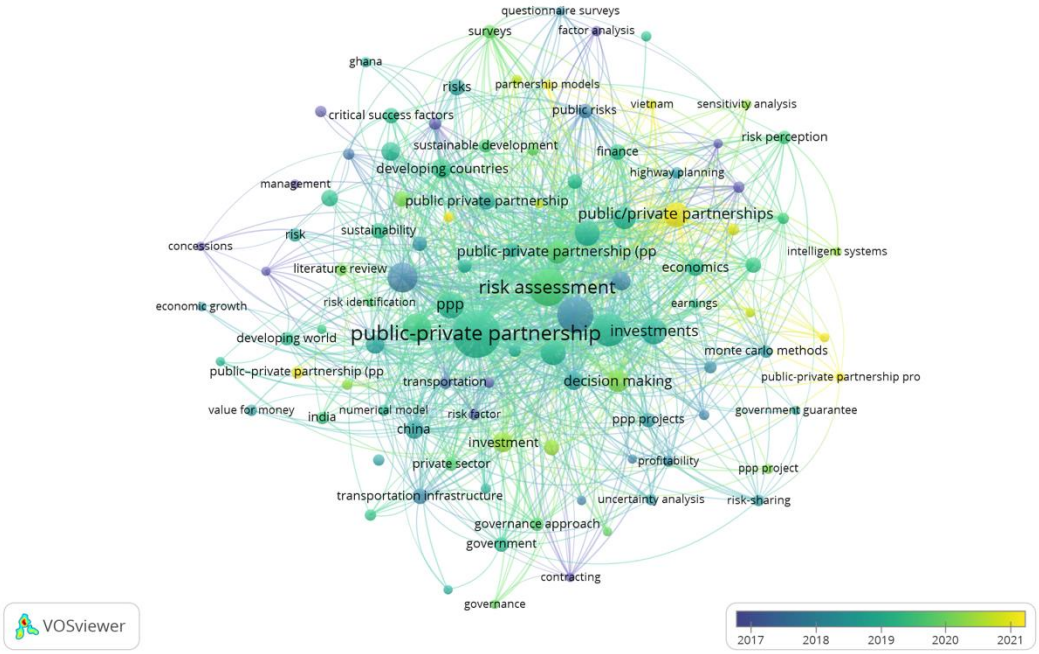

Figure 8. Research theme risk aspect in PPP infrastructure
Source: Authors' creation (2024)

DISCUSSION

Risk aspects in PPP infrastructure have been recently analyzed by scholars globally from diverse perspectives, with different methods, and on a variety of sectors, including toll roads and freeway (Fathi & Shrestha, 2023; Jokar et al., 2021, 2023; Putri et al., 2023; Zapata Quimbayo & Mejía Vega, 2023), urban rail (city) transit (Feng et al., 2021; Sun et al., 2023), water infrastructure (Amiri et al., 2022; Bao et al., 2022; Lima et al., 2023; Moradi Shahdadi et al., 2023; Y. Zhang et al., 2021), wastewater infrastructure (Amiri et al., 2022; Moradi Shahdadi et al., 2023), energy infrastructure (Kouton et al., 2023), sludge treatment (Fan et al., 2022), social housing (Chiang et al., 2022), hydropower facilities (Braeckman et al., 2022), seaport (Liyanage & Villalba-Romero, 2021; Sumrit, 2021), and electricity infrastructure (Hartono et al., 2021).

Many methodologies are now employed for risk analysis in PPP infrastructure. For quantitative approaches, they include the Monte Carlo simulation technique (Zapata Quimbayo & Mejía Vega, 2023), system dynamics approach (Sun et al., 2023), fuzzy multi-criteria (Dorfeshan et al., 2022; Feng et al., 2021; Jokar et al., 2021, 2023; Sumrit, 2021; Y. Zhang et al., 2021), and statistic or model approach (Belghiti & Angade, 2023; Chiang et al., 2022; Fan et al., 2022; Ramli et al., 2021). As for qualitative approaches, they cover Delphi technique (Fathi & Shrestha, 2023; Moradi Shahdadi et al., 2023; Tamošaitienė et al., 2021), semi-structured interviews (Akhtar et al., 2023), normative legal research (J. Zhang et al., 2021), and mixed method approach (Amiri et al., 2022; Bao et al., 2022; Chen et al., 2023; Hartono et al., 2021; Khahro et al., 2021; Li & Wang, 2023; Lima et al., 2023; Liyanage & Villalba-Romero, 2021; Mazher et al., 2022; Putri et al., 2023; Zhai et al., 2021).

Keyword co-occurrence network reveals a few remarkable trends. Studies on risk aspects in PPP infrastructure from 2014 to 2017 focused on PPP, risk factors, concessions, crucial success criteria, development projects, toll highways, water supplies, contracts, and social infrastructure. Between 2018 and 2020, the next wave of risk aspects in PPP infrastructure research centered on PPP, risk assessment, risk analysis, risk management, risk sharing, value for money, project management, merger and acquisition, infrastructure projects, investment, stakeholder, India, China, surveys, and governance. Since 2021, risk analysis in PPP infrastructure research has primarily focused on PPP, costs, urban growth, Vietnam, investment, partnership models, private sectors, private investment, internet protocols, and intelligent systems.

The ongoing research on risk aspects in PPP infrastructure focuses on current contextualized risks with technology such as internet protocols and intelligent systems within the PPP infrastructure framework. A great number of studies have also explored perspectives from the business sectors, such as investment, cooperation models, and costs. The common story fetishes research explains that risk assessment, risk analysis, risk sharing, and risk management were prominent subjects three to five years ago. Some studies have also linked countries such as China, India, and Vietnam to the risk factors in PPP infrastructure.

Our findings on top authors, countries, and institutions show that scholars and educational institutions do not have a dominant position in research on risk in PPP infrastructure. One probable explanation for this result is the availability of research funds, as well as the prominence of risks in PPP infrastructure as a top research trend among researchers and institutions.

This study examined the current literature for mapping the bibliometric characteristics and understanding the framework of the risk aspects in PPP infrastructure. The researcher was concerned with the main issues of authors, countries, institutions, financing, publication outlets, papers, and subjects of risk-related research in PPP infrastructure from 2014 to 2024. We focused specifically on leading authors, highly cited publications, and co-occurring keywords.

Some discussions of our bibliometric review are summarized below:

1. The research elements of PPP infrastructure show consistent growth, with the majority of publications being released within the recent year.

2. *Journal of Construction Engineering and Management* was the most popular publication outlet, followed by *Sustainability*, *Journal of Management in Engineering*, and *Journal of Infrastructure Systems* in the research on risk aspects in PPP infrastructure.

3. Chan, A. P. C. from the Hong Kong Polytechnic University, Hong Kong, and Ameyaw, E. E. from the University of Northumbria, Newcastle, United Kingdom were the top contributing authors.

4. Emerging markets like China, India, Malaysia, and South Africa lead the top 10 countries contributors, creating an opportunity for scholars to research on risk aspects in PPP infrastructure.

5. The articles authored by Wang et al. (2018) had the highest global citations, followed by Chou and Pramudawardhani (2015) and E. E. Ameyaw and A. P. C. Chan (2015).

For the Indonesian context, there are no categories related to the country in the top list categories of bibliometric analysis on risk aspects in PPP infrastructure from 2014 to 2023. Compared with other Asian emerging markets in Asia, China, Malaysia, Vietnam, and Iran are the 10 biggest countries that dominantly contributed and published research on risk aspects in PPP infrastructure. Apart from that, institutions in China (The Hong Kong Polytechnic University and Dalian University of Technology), Iran (University of Tehran), and Thailand (Chulalongkorn University) have invested in research and are included in the 10 leading funding sponsors regarding the topic. In terms of research objects, China, India, and Vietnam have become research topics for risk aspects in PPP infrastructure in the past decade. This also coincides with infrastructure development and economic growth in the three countries.

The risk aspects of PPP infrastructure are important factors to consider when developing infrastructure under the PPP scheme. Many stakeholders in Indonesia should conduct more in-depth research on the risk components of PPP infrastructure, including finance supports, prioritizations, and facility accesses. Finally, it is envisaged that Indonesia would become a global research reference and have a direct impact on infrastructure development through a sustainable PPP scheme that meets various stakeholders' attainment criteria.

CONCLUSION

The risk aspect is essential in PPP infrastructure since it may have a direct impact on the cost, income, and ease of the project. This bibliometric analysis of the literature allowed us to extract the bibliometric aspects and conceptual structure of this topic in existing studies, as well as identify future research themes to improve our comprehension of risk aspects in PPP infrastructure. The findings have demonstrated risk considerations must be employed as the main approach in infrastructure development, implementation, and operation instead of complementing analysis. Institutions that overlook risk aspects may have difficulties in creating and managing their primary infrastructure under the PPP scheme.

Our review also demonstrates the need for scholars to use a variety of approaches in addition to existing ones when analyzing relevant concerns. Computational tools based on machine learning, simulation, and mathematical modeling can bring novelty to the risk aspects of PPP infrastructure. Research on risk factors in PPP infrastructure utilizing a technological concept approach is similarly scarce. As a result, we encourage future research to be bolder and more original in developing risk elements in PPP infrastructure research by employing non-traditional approaches to examine risk aspects in diverse PPP infrastructure sectors.

To that end, the study of risk factors in PPP infrastructure will continue to be appealing to academics, practitioners, and policymakers as the business climate changes both domestically and internationally. There is also a need to investigate breaking down silos through improved collaboration among stakeholders from diverse countries and institutions. We are convinced that our recommendations and demands for increased collaboration in research on the risk aspects of PPP infrastructure are beneficial to players in the industry, especially in the context of infrastructure development in Indonesia. Through reputable research fields with a

focus on risk aspects in the PPP scheme, Indonesia (both in terms of researchers, research topics, organizations, and research sponsors) will be at the top of the risk aspect research ranking in PPP discourse and implementation. On the other hand, to get ahead of the existing trends, researchers or stakeholders in Indonesia should conduct research related to risk aspects in PPPs with a focus on conducting studies of novel themes such as risk aspects viewed from technological concepts and perspectives of business entities within the framework of the PPP scheme.

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Financial and Efficiency Performance before and after Mergers and Acquisitions in the Indonesian Infrastructure Industry

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ABSTRACT

This study examines the differences in the financial and efficiency performance of several companies before and after Mergers and Acquisitions (M&A). It specifically evaluates the impacts of M&A on infrastructure industry companies listed on the Indonesia Stock Exchange by comparing their performance three years before and three years after M&A. The analysis employs non-parametric statistics, including the Wilcoxon Signed Rank Test, and Data Envelopment Analysis (DEA). The companies' financial performance is assessed using various financial ratios: Current Ratio (CR), Debt to Equity Ratio (DER), Cash Ratio (CR), Interest Coverage Ratio (ICR), Fixed Asset Turnover (FAT), Total Asset Turnover (TATO), Return on Asset (ROA), Return on Equity (ROE), and Net Profit Margin (NPM). The data used is secondary data obtained from the Indonesia Competition Commission (ICC/KPPU), the IDX database, and the financial reports of the companies involved. The findings reveal that, overall, the financial and efficiency performance of the five companies did not improve after the M&A. Surprisingly, only one company, i.e., Adhi Karya, successfully increased its efficiency score following the M&A.

Keywords: DEA analysis; Financial ratio; Infrastructure; M&A

ABSTRAK

Penelitian ini mengkaji perbedaan kinerja keuangan dan efisiensi beberapa perusahaan sebelum dan sesudah Merger dan Akuisisi (M&A). Penelitian ini membandingkan pengaruh M&A terhadap perusahaan industri infrastruktur yang terdaftar di Bursa Efek Indonesia dalam tiga tahun sebelum dan sesudah M&A. Analisis melibatkan metode statistik nonparametric, di antaranya Wilcoxon Signed Rank Test dan Data Envelopment Analysis (DEA). Performa finansial perusahaan dinilai berdasarkan beberapa rasio keuangan, yaitu *Current Ratio* (CR), *Debt to Equity Ratio* (DER), *Cash Ratio* (CR), *Interest Coverage Ratio* (ICR), *Fixed Asset Turnover* (FAT), *Total Asset Turnover* (TATO), *Return on Asset* (ROA), *Return on Equity* (ROE), dan *Net Profit Margin* (NPM). Peneliti juga menggunakan data sekunder yang diperoleh dari KPPU, *database* BEI, dan laporan keuangan masing-masing perusahaan. Hasil penelitian menunjukkan bahwa secara keseluruhan kelima perusahaan tidak menunjukkan peningkatan performa setelah M&A. Menariknya, hanya satu perusahaan, yaitu Adhi Karya, yang berhasil meningkatkan skor efisiensinya pasca M&A.

Kata Kunci: Analisis DEA; Infrastruktur; M&A; Rasio keuangan

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INTRODUCTION

Companies expect that mergers will result in better financial and efficiency performance. Although the annual trend in Indonesia is unlikely similar, corporate actions that carry out Mergers and Acquisitions (M&A) tend to increase in the last ten years. According to the Indonesia Competition Commission (ICC/KPPU) from 2010 to June 2020, as shown in Figure 1, M&A trends in Indonesia reached 633 notification reports from business actors (Setiawan et al., 2021). The data also shows that more than 100 companies conducted M&A, as reported by ICC (Setiawan et al., 2021). This indicates that more companies are practicing M&A but do not notify the Indonesia Competition Commission (KPPU) because the value does not meet the provisions stipulated in Law No. 5 of 1999.

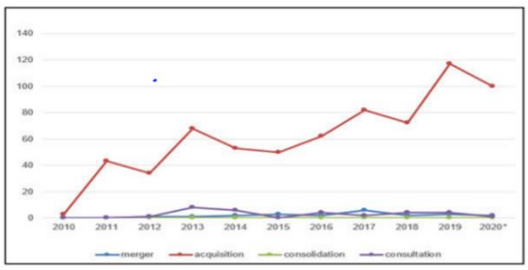

Figure 1. Merger notification (2010 to June 2020)

There are several definitions of M&A. Even though the phrases “merger” and “acquisition” have different meanings, both are frequently used interchangeably (Chiplin & Wright, 1987) to notify an acquisition that occurs when an acquirer purchases the majority of the shares (more than 50%) of another company (the “target”) or parts thereof. A merger results in a new company in which the merging parties have about equal control. Acquirers frequently use the term “merger” to calm employee fears and portray a message of friendly cooperation. In terms of transaction volumes, most M&A transactions are acquisitions; nonetheless, mega-merger collaborations attract media attention due to the transaction size (Junni & Teerikangas, 2019).

Another explanation is that a merger is uniting two or more companies into one, to form a new company with a new name. The acquisition is a takeover of a company by another company so that the company has control over the target company. The acquisition strategy is increasingly popular because of the relatively extreme business competition. The underlying reason behind M&A action is the belief that it is a fast-response method to materialize the company’s goals by not starting a business from scratch. At the same time, this strategy is also envisaged to improve the company’s financial performance (Hariyani et al., 2011). The researchers used the infrastructure industry as the unit of analysis for this study, which aimed to examine the impact of the merger and acquisition activities from 2014 to 2019.

President Joko Widodo (2017) argued that the government wanted to create higher economic growth, both in the medium and long term, while the infrastructure was still far from ideal conditions and even tended to deteriorate. The President cited a 2013 World Bank and Bloomberg McKinsey report, which showed that Indonesia's infrastructure stocks were low, accounting for only 38% of GDP, compared to other countries' average of 70%. Furthermore, compared to the pre-Asian economic crisis of 1997-98, Indonesia's entire infrastructure stocks fell from 49% of GDP in 1995 to 38% in 2012.

The researchers are interested in scrutinizing more about infrastructure companies in Indonesia. Among the many companies in Indonesia engaged in the infrastructure industry, the researchers are interested in studying PT Jasa Marga Tbk (JSMR), PT Wijaya Karya Beton Tbk (WTON), PT Waskita Karya Tbk (WSKT), PT Nusantara Infrastructure Tbk (META), and PT Adhi Karya Tbk (ADHI). Meanwhile, as many as four out of the five companies made acquisitions, only one company, i.e., ADHI, conducted a merger.

On 15 January 2014, PT Nusantara Infrastructure Tbk, through its subsidiary PT Telecom Infranusantara (TI), acquired 70,17% shares of PT Tara Cell Intrabuana, which then changed its name to PT Komet Infranusantara (KIN). Such an acquisition aims to support the growth in the telecommunications tower segment (PT Nusantara Infrastructure Tbk, 2014). On 5 December 2014, PT Wijaya Karya Beton Tbk acquired 99,5% shares of PT Citra Lautan Teduh, a company in the pile manufacturing business. The acquisition was carried out to improve production capacities through consolidation and market expansion (PT Wijaya Karya Beton Tbk, 2014).

In 2015, PT Jasa Marga acquired by buying 59,99% and 55,00% shares from PT Solo Ngawi Jaya and PT Ngawi Kertosono Jaya, respectively. The acquisition activity is an effort of PT Jasa Marga to maintain its position as the leader in the Indonesian toll road industry (PT Jasa Marga Tbk, 2015). Still in the same year, the next company, PT Adhi Karya Tbk, merged two subsidiaries, i.e., PT Adhi Persada Properti and Adhi Persada Realti. The merger, which was inaugurated on 18 June 2015, is because the company wished to encourage the subsidiary to carry out an Initial Public Offering (IPO) so that this target company provides an opportunity to receive an injection of funds for its business expansion (PT Adhi Karya Tbk, 2015).

Lastly, PT Waskita Karya Tbk acquired PT Pemalang Batang Toll Road on 15 February 2016 by taking over 60% of the shares. On 29 May 2017, the company made another acquisition by taking over 55% of the shares of the Cibitung-Cilincing toll road from PT MTD CTP Expressway. The acquisition activities are expected to trigger an increase in the accessibility and capacity of the road network in serving the traffic in the Trans Java corridor (PT Waskita Karya Tbk, 2017).

Financial performance analysis is vital for an enterprise's achievement. A financial ratio is an exceptional ratio that examines the company's business performance (Daryanto et al., 2020). This study compares the efficiency and financial performance of the five companies in the three years before and after M&A and compares the company's performance to industry average financial ratios. The Wilcoxon Signed Rank Test calculates the mean statistical difference between the financial performance before and after M&A.

The topic of financial and efficiency performance before and after M&A in Indonesia's infrastructure industry is of significance for some reasons. First, the infrastructure sector is an important driver of economic growth, supporting commerce, investment, and general development. Besides, Indonesia, with its wide archipelagic topography and rising economy, has a strong demand for efficient and resilient infrastructure. M&A in this sector may result in significant improvements in operational efficiency, financial performance, and service delivery. This study focuses on the effectiveness of M&A strategies in improving the competitiveness and sustainability of infrastructure corporations by assessing the financial and efficiency results of such actions.

The existing literature lacks of concentrated research on the impact of M&A particularly in the Indonesian infrastructure sector context. While there is a large body of research on M&A in general, as well as some studies on infrastructure development, there is little empirical evidence comparing the financial and operational performance of Indonesian infrastructure corporations before and after M&A. This study seeks to fill in this gap by conducting a thorough investigation of how M&A operations affect important performance parameters such as profitability, efficiency, and financial stability in this vital industry.

This study contributes to the area by providing a detailed knowledge of the implications of M&A for infrastructure companies, which can be used to drive future business plans and investments. The findings of the present study are essential to inform industry practices by highlighting best practices for successful integration and identifying characteristics that influence post-merger performance.

This research can also have an impact on policy making by presenting evidence-based suggestions for regulatory frameworks that promote effective M&A, thereby building a more competitive and resilient infrastructure sector in Indonesia. Finally, this study enhances academic understanding and amplifies practical consequences for improving the efficiency and financial health of infrastructure corporations, which is essential for Indonesia's economic development.

THEORETICAL FRAMEWORK

Types and Motives of M&A

A merger combines two or more companies to form a new company (Whitaker, 2012). Usually, a dominant company absorbs one or more companies. There are three types of mergers: horizontal, vertical, and conglomerate (Ahmed & Ahmed, 2014; Gordon, 2024; Yadong et al., 2019). Meanwhile, an acquisition is a single or multiple transaction in which a firm purchases the assets or shares of another company to gain control of it. Several types of acquisitions are friendly, reverse, and hostile (Ganti, 2024).

Mergers and acquisitions (M&A) are often strategies that a company chooses to achieve its goals. Therefore, M&A can also be differentiated based on motives. In general, there are two motives for conducting M&A, i.e. shareholder gains and managerial gains (Taringan et al., 2018).

M&A aims to increase not only the company values but also the actual or future profits. This goal, which is essentially related to shareholder gain, is further discussed in the following eight merger motives:

1. Growth

   The most common motive for M&A is growth. Growth here can be interpreted broadly, such as revenue growth, profit margin growth, and other growth. The company's desire to grow is the most basic motive for practicing M&A. In fact, apart from growing via M&A, companies have some other alternatives, such as through internal or organic growth, where the company can grow internally without M&A with other companies. However, the tendency of this choice is usually slower compared to M&A.

2. Operational synergy

   Synergy comes from the Latin word *"synergos"*, which means to work together. In the context of M&A activities, synergy means extra results obtained when two or more companies carry out a business combination. Synergies are created from a combination of the simultaneous activities of two or more company forces that give greater results or effects rather than these companies working separately or independently.

   When it comes to economies of scale, a corporation is said to achieve this scale if its average cost falls as total output rises. In other words, economies of scale arise when increased production reduces marginal costs. From the economic scope and perspective, it is the economies of scale that apply to multi-product organizations or companies that are connected to a supply chain. The economy of scope can be realized if the average cost of producing two things individually decreases when they are produced jointly (Motta, 2004, as cited in Tarigan, 2016).

3. Financial synergy

   Financial synergy does not result in true cost savings particularly in production costs (Roller, Stennek, & Verboven (2006). Financial synergy can be obtained by saving on interest rates (cost of capital), often unable to borrow at competitive interest rates from relatively small companies.

   These companies often have lower loan withdrawal limits. This is due to the restrictions of regulations from banks in providing credit. The limits in question can occur due to a lack of liquidity, solvency, total assets, and the company's public reputation.

4. Diversification

   Diversification is a strategic motive aimed at reducing the risk of bankruptcy by engaging in business activities across various sectors. This approach allows a company to better withstand sector-specific downturns by spreading risk. Diversification is essential for maintaining competitiveness and supporting business sustainability. It is a key motive for M&A, aligning with portfolio theory commonly used in finance and investment. Portfolio theory suggests that spreading investments across different sectors minimizes risk and enhances returns.

   Through diversification, companies can secure more stable performance. Companies can mitigate the impact of sector-specific challenges while achieving improved financial outcomes. This kind of strategic diversification supports the companies' long-term growth and resilience in an unpredictable economic environment.

5. Horizontal integration

   The purpose of a merger in this context is to shift markets from perfect competition towards a monopoly. However, almost every country has an agency to maintain fair trade competition by ensuring that no private company has a monopoly market. In Indonesia, this agency is known as the Indonesia Competition Commission (KPPU).

   Horizontal integration motive occurs in M&A activities of companies in the same sector. By operating in the same sector, the company resulting from the merger is likely to have a higher market share than that of working separately. The advantage of a horizontal merger goes beyond solely market share, extending to other benefits.

6. Vertical integration

   Vertical integration usually involves the acquisition of companies playing a role in the upstream (backward) or downstream (forward) side. The upstream side (backward vertical integration) is buying companies that are a source of supplies or that act as suppliers. By carrying out vertical integration, companies that carry out M&A are free from dependence on other parties, enabling both just-in-time inventory management (which is essential for increasing the company's efficiency) and internal transfer pricing (which is very dependent on supplier performance). Just in-time can only succeed when suppliers are reliable.

   Vertical integration is useful in enabling the successful implementation of just-in-time inventory management. In addition, internal transfer pricing is more profitable for the company because it allows the company to get cheaper acquisition prices and lower taxes.

7. Improved management

   If the companies that carry out M&A has technological capabilities, human resources, organizational culture, patents, and know-how, then they are complementary to each other. By joining forces, the companies can achieve technological progress. Product or process innovation can be used to represent technological development. As with know-how, Research and Development (R&D) is one of the most crucial divisions in the company. When properly merged, it can result in technical growth and a rise in joint outputs.

   According to Roller, Stennek, and Verboven (2006), acquiring a target company with good R&D is far much quicker way than developing a company itself internally. Indeed, merger companies have acknowledged that those integrating their R&D appropriately will be able to develop faster in introducing new products and products of better quality, and are useful in the process of reducing prices.

8. Tax motives

   The tax motive is one of the motives on which M&A activities are based. When a company has more cash and there is no economically viable internal investment opportunity, the company can carry out M&A activities. In other words, buying another company can be the "best" way to avoid taxes.

   M&A before the 1980s were very motivated by tax advantages. The reason is that the purchased assets can be profitable because they provide a greater depreciation cost so as to reduce the tax liability that arises.

Besides its potential to achieve synergy and benefiting the acquiring firm's shareholders (Rohra & Chawla, 2015), M&A is also carried out to achieve managerial costs. M&A is sometimes aimed at benefitting the company manager (managerial gains) and is not always for the company's benefit. In other words, the purpose of M&A is solely for the benefit of company management, not the owners.

Financial Ratios

A financial report is a tool frequently used by businesses to communicate the situation and financial condition of a company to both internal and external stakeholders (Serly & Eddy, 2020). A financial ratio is an index that connects two accounting numbers and divides one number by another. Financial ratios play an important role in revealing the financial health of a company. They help maintain the competitive position of an enterprise and contribute to stable development, thereby eliminating potential financial risks (Kliestik, 2020). The tool often used during these checks is a financial ratio or index that links two pieces of financial data by dividing one number by the other. Types of financial ratios are as follows:

1. Liquidity Ratio

   By comparing short-term liabilities with short-term resources—also known as current resources—that are available to cover these obligations, the liquidity ratio assesses the company's capacity to meet short-term obligations. The liquidity ratio consists of:

   a. Current Ratio

   The current ratio shows a company's ability to pay its short-term liabilities using its current assets.

$$Current\ Ratio = \frac{Current\ assets}{Current\ liabilities}$$

   b. Acid-Test Ratio (Quick Ratio)

   The ratio indicates the company's ability to meet and pay its liabilities or current debt (short-term debt) with current assets, without regard for inventory value. The formula for calculating a quick ratio is:

$$Quick\ Ratio = \frac{Current\ assets - Inventory}{Current\ liabilities}$$

   c. Cash Ratio

   The quick ratio, which measures how much cash is available to settle short-term debt or current liabilities, is refined into the cash ratio. This ratio is typically used by potential creditors to measure a company's liquidity and ease of paying off short-term debt.

$$Cash\ Ratio = \frac{Cash\ Equivalents + Cash}{Current\ liabilities}$$

2. Efficiency Ratio

   The efficiency ratio is the ratio that measures the effectiveness of a company in managing its assets, i.e., measuring the ability of all its assets to generate sales. This ratio consists of:

   a. Fixed Asset Turnover Ratio

   The fixed asset turnover ratio measures the efficacy of a company in using its plants and equipment. The formula is:

$$Fixed\ Asset\ Turnover = \frac{Revenue}{Fixed\ Asset}$$

   b. Inventory Turnover

   This ratio shows the frequency of the item "rolls" in a year. The formula is:

$$Inventory\ Turnover = \frac{COGS}{Inventory}$$

c. Total Asset Turnover

This ratio is used to measure the turnover of all company assets. The formula for calculating the total asset turnover is:

$$Total\ Asset\ Turnover = \frac{Net\ Sales}{Total\ Asset}$$

3. Leverage Ratio

A leverage ratio is a ratio that shows the extent to which the company is paid by debt. This ratio shows the proportion of debt used to finance investment. Companies that do not have leverage use 100% of their capital. The leverage ratio is divided into:

a. Debt Ratio

A debt ratio is a financial ratio showing the asset percentage provided through debt. The debt ratio can be defined as the ratio of total debt to total assets. The formula for calculating the debt ratio is:

$$Debt\ Ratio = \frac{Total\ Liabilities}{Total\ Asset}$$

b. Debt to Equity Ratio (DER)

This ratio is used to calculate the ratio of debt to total equity. Total debt includes all current liabilities and long-term debt. The formula:

$$Debt\ to\ Equity\ Ratio\ (DER) = \frac{Total\ Liabilities}{Total\ Equity}$$

c. Interest Coverage Ratio

It is the ratio of debt and profitability used to determine how easily a company can pay its loan interest. The interest payment multiple ratios measure the extent to which operating profit can decrease before the company cannot meet its annual interest expense. The formula for calculating the interest coverage ratio is:

$$Interest\ Coverage\ Ratio\ (ICR) = \frac{EBIT}{Interest\ Expense}$$

4. Profitability Ratio

The profitability ratio illustrates how debt, asset management, and liquidity affect operating performance. This ratio consists of:

a. Gross Profit Margin

Gross Profit Margin (GPM) compares gross profit to previous sales or income. GPM is an analysis that measures a company's financial health by assessing the amount of money left over after deducting the Cost of Goods Sold (COGS). The formula for calculating gross profit margin is:

$$Gross\ Profit\ Margin = \frac{Gross\ Profit}{Net\ Sales} \times 100$$

b. Net Profit Margin

This ratio shows how much operating profit can be made from each currency (IDR or the US) sales. The formula for calculating the profit margin on sales is:

$$Net\ Profit\ Margin = \frac{Net\ Income}{Net\ Sales} \times 100$$

c. Operating Profit Margin

Operating Profit Margin (OPM) is a performance ratio that reflects the percentage of profit a company produces from its operations. The formula for calculating the operating profit margin is:

$$Operating\ Profit\ Margin = \frac{Operating\ Profit}{Net\ Sales} \times 100$$

d. Return on Asset (ROA)

This ratio shows the company's assets and ability to profit from the company's operations. Operational assets are used to measure the ability to earn a profit.

$$ROA = \frac{Net\ Income}{Total\ Asset} \times 100$$

e. Return on Equity (ROE)

The ratio of net income to common stock equity generally measures the return on equity of common stock (ROE) or the rate of return on investment of shareholders. The formula is:

$$ROE = \frac{Net\ Income}{Total\ Equity} \times 100$$

Variables for DEA Analysis

The non-parametric technique known as DEA was first introduced by Charnes et al. (1978), later referred to as Charnes, Cooper, and Rhode (CCR). In 1984, Banker, Charnes, and Cooper (BCC) expanded on this concept. Decision-Making Unit (DMU) efficiency is determined by DEA. The model's inputs and outputs determine the meaning and goal of the analysis. Inputs and outputs should be logically linked, as this is a production process (Krejnus et al., 2023). The ratio is derived from weighted outputs to weighted inputs. The variables are as follows:

1. Fixed Assets (Input Variable 1)—It is comparable to the physical capital that every business needs. This study employs the same variable as earlier research (Jayaraman & Srinivasan, 2014; Chaudhary & Arshad, 2016).

2. Salary Expense (Input Variable 2)—Employee factor is strongly related to the production process. This analysis uses the variable of previous studies (Jayaraman & Srinivasan, 2014; Chaudhary & Arshad, 2016).

3. Revenue (Output Variable 1)— Because the study employs an income-based model, the revenue accurately represents corporate income. Therefore, the variable is also used in accordance with the past studies (Chaudhary & Arshad, 2016; Jayaraman & Srinivasan, 2014).

METHODOLOGY

Research Design

This section explains more about the research framework, along with the hypothesis of all variables. The sections below describe the research instrument, the sample, and the data analysis method.

This study uses non-parametric statistical models such as:

1. Descriptive statistics use frequency, mean, minimum, maximum, and standard deviation to provide data (Sekaran & Bougie, 2016).

2. The paired sample t-test compares two sets of observations from the same person, entity, or unit at separate periods to determine if the mean difference is significantly greater than zero. The Wilcoxon Signed Rank Test is a prominent method for paired sample T-testing. It is a non-parametric statistical method that does not assume that the data is normally distributed or that a minimum sample size is required.

3. Chaudhary et al. (2016) use the income-based model to assess the impact of M&A on firm efficiency. This model considers expenses as inputs and income as outputs. This research employs methods from DEA Online Software.

Research Framework

The research framework for this analysis is shown in Figure 2.

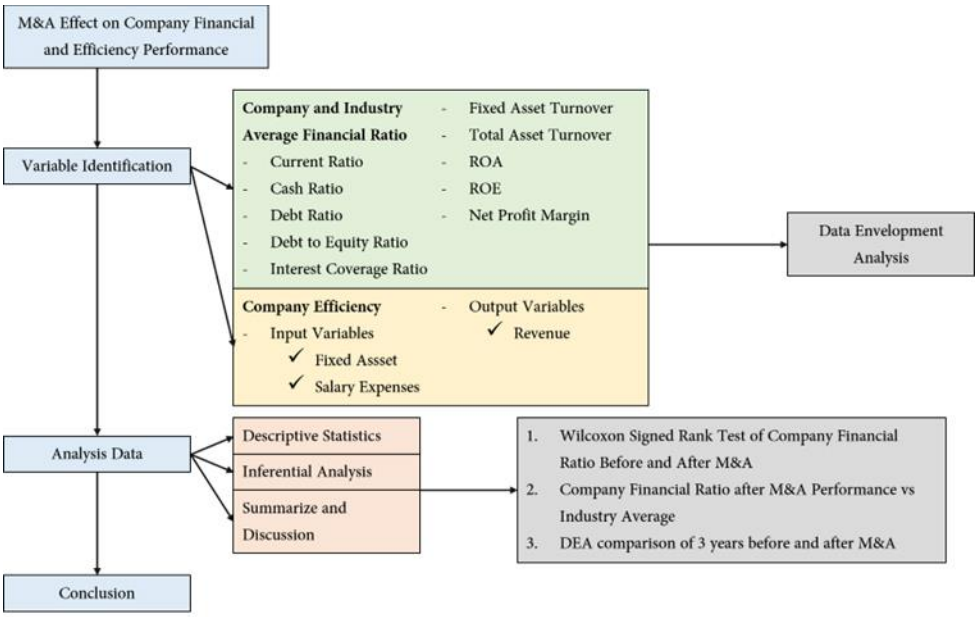

Figure 2. Research framework

Hypotheses

Based on the research framework, the hypotheses for this study are as follows:

1. H_{01}: There is no significant difference in company financial ratios before and after M&A (Current Ratio, Cash Ratio, Debt Ratio, Debt to Equity Ratio, Interest Coverage Ratio, Fixed Asset Turnover, ROA, ROE, Net Profit Margin).

   If the value > 0,05, H_{01} is accepted.

   H_{a1}: There is a significant difference in company financial ratios before and after M&A (Current Ratio, Cash Ratio, Debt Ratio, Debt to Equity Ratio, Interest Coverage Ratio, Fixed Asset Turnover, ROA, ROE, Net Profit Margin).

   If the value < 0,05, H_{01} is rejected.

2. H_{02}: The company's financial ratios do not surpass the industry average (Current Ratio, Cash Ratio, Debt Ratio, Debt to Equity Ratio, Interest Coverage Ratio, Fixed Asset Turnover, ROA, ROE, Net Profit Margin).

   H_{a2}: The company's financial ratios surpass the industry average (Current Ratio, Cash Ratio, Debt Ratio, Debt to Equity Ratio, Interest Coverage Ratio, Fixed Asset Turnover, ROA, ROE, Net Profit Margin).

3. H_{03}: After M&A, the company's performance (DEA) does not improve in efficiency compared to before M&A.

   H_{a3}: After M&A, the company's performance (DEA) improves in efficiency compared to before M&A.

Data Source

This study applies non-probability sampling, which is homogeneous sampling. According to Etikan et al. (2017), homogenous sampling focuses on a sample with the same features. The five firms being studied satisfy the following criteria:

1. Infrastructure companies listed on the Indonesia Stock Exchange that experienced M&A activities from 2014 to 2019.

2. The samples should be non-financial firms. Because the financial sector has various ratios and analyses, it would be impractical to combine the financial and non-financial companies in the research.

3. The company's financial data are valid for three years before and after M&A.

4. Throughout the study time, the acquired firm must be registered on the Indonesia Stock Exchange, be listed there, and not be a foreign company.

5. The types of M&A are horizontal and vertical to ensure that the company's output after M&A can be correlated with the industry average. Because conglomerates are likely to operate in more than one industry context, it will be difficult to access the comparison.

6. The sample company is a company that has informed its M&A operations in both KPPU and IDX.

FINDINGS

PT Jasa Marga Tbk (JSMR)

PT Jasa Marga Tbk, formed on March 1, 1978, is Indonesia's largest toll road operator, known for its significant network and innovative services. Founded as a state-owned enterprise, the corporation went public in 1987, trading on the Indonesia Stock Exchange under the ticker symbol "JSMR". JSMR has led various major infrastructure projects, including the Jakarta Outer Ring Road in 1995 and the Trans-Java Toll Road in 2017. The corporation has evolved from a minor state operation to a major player in Indonesia's toll road industry, handling over 1.200 kilometers of toll roads, accounting for around 60% of the country's total toll road network. JSMR's strategic government support, technological improvements, and skill in large-scale projects provide it a strong market position and competitive advantage.

JSMR is financially strong, with revenues of IDR11,5 trillion and a net profit margin of approximately 18% for fiscal year 2023. The company's assets were valued at IDR60 trillion by the end of 2023, showing its consistent expansion and ongoing infrastructure investment. In recent years, the corporation has made considerable investments in digital infrastructure, aiming to improve efficiency and customer experience via electronic toll systems. Despite a balanced debt-to-equity ratio of 1.5, JSMR has an excellent financial performance, with a 7% compound annual revenue growth rate over the last five years. The corporation is still expanding its toll road network, with a focus on crucial regions that drive economic growth. With its extensive network, strategic support, and innovative approach, JSMR is a cornerstone of Indonesian infrastructure development, prepared to maintain its sector leadership.

PT Wijaya Karya Beton Tbk (WTON)

WTON, a subsidiary of PT Wijaya Karya Tbk (Persero), was founded in 1997 and has since become a key participant in Indonesia's precast concrete sector. Initially, the company focused on making precast concrete components for its parent company's construction projects. As time goes by, WTON extended its business, becoming a vital supplier for a variety of infrastructure projects throughout Indonesia. An important milestone was its first public offering in 2014, which reinforced its capital foundation and allowed for continued expansion. WTON's transition from a

supporting role in its parent firm to an independent industry leader demonstrates its growth trajectory and commitment to innovation.

Today, WTON commands a sizable market share in Indonesia's precast concrete industry. The company's competitive advantages include a strong manufacturing capacity, a large distribution network, and a comprehensive product portfolio that serves a wide range of construction needs, from bridges to high-rise structures. WTON runs multiple manufacturing sites strategically positioned throughout Indonesia to ensure effective distribution and timely delivery of its products. The company's significant experience with large-scale projects has been its strong emphasis on quality and innovation. Their extensive experiences have helped establish the company as a market leader in the precast concrete sector in Indonesia.

WTON has delivered strong financial results. In 2023, the company reported revenues of over IDR5,7 trillion and a net profit margin of about 12%, demonstrating its operational efficiency and profitability. The company's asset base exceeded IDR10 trillion, which demonstrates its ability to grow and invest in new technologies and facilities. WTON's recent financial performance shows a consistent increase in both revenue and profit, indicating a robust demand for precast concrete products in Indonesia's thriving building industry.

With a focus on growing production capacities and improving product quality, WTON is well-positioned to maintain its leadership in the precast concrete sector and contribute significantly to Indonesia's infrastructure development.

PT Waskita Karya Tbk (WSKT)

PT Waskita Karya Tbk. is a well-known Indonesian construction business established in 1961. Founded as a state-owned corporation, it plays an important part in the development of infrastructure projects throughout Indonesia. WSKT underwent a considerable shift in 2012 when it went public and was listed on the Indonesia Stock Exchange under the ticker symbol "WSKT". Since then, the company has expanded its operations to cover a wide variety of construction projects, including toll roads, bridges, airports, and residential buildings.

Among its notable achievements are the completion of numerous important toll roads and urban infrastructure projects, which have considerably boosted Indonesia's connectivity and urban development. WSKT has transformed from a traditional construction firm into a significant leader in the infrastructure industry.

WSKT is a dominant player in the Indonesian construction industry, with a sizable market share. Its competitive advantages stem from its wide project portfolio, strong government ties, and skill in delivering huge and complex infrastructure initiatives. Civil construction, engineering, and investment in toll road concessions are major areas of activity for the corporation as they provide a consistent revenue stream and potential for expansion. WSKT is known for its capacity to manage high-profile projects of Indonesian infrastructure development, such as the Trans-Java Toll Road and the expansion of Soekarno-Hatta International Airport.

WSKT has experienced substantial financial growth. In 2023, the company announced revenues of IDR22 trillion, demonstrating its significant market presence and large project commitments. Despite confronting obstacles such as variable profit margins (a recent net

profit margin of roughly 6%), the company has maintained a strong asset base valued at around IDR80 trillion. The recent financial performance highlights include a focus on debt reduction and improving operational efficiency to increase profitability.

To ensure long-term growth, the company intends to optimize its financial structure and diversify or expand its project portfolio. WSKT is an important part of Indonesia's infrastructure development, positioned to maintain its leadership in the construction industry and contribute to economic growth. The company has demonstrated vital roles in Indonesian infrastructure management and development.

PT Nusantara Infrastructure Tbk (META)

META is a major Indonesian infrastructure investment business founded in 1995. Originally known as PT Sawitia Multipurpose Bank, the corporation underwent extensive reorganization and rebranding in 2006 to focus on infrastructure development. It has subsequently evolved into a prominent participant in Indonesia's infrastructure industry, with expertise in toll road management, water treatment, port services, and telecommunications towers.

The move to an infrastructure-focused corporation marked a watershed moment in its history, allowing META to capitalize on Indonesia's expanding need for infrastructure development. META has grown from a financial institution to a diversified infrastructure corporation, contributing much to the country's infrastructure capacity.

META has a considerable market share in Indonesia's infrastructure industry. The company's competitive advantages include a diverse portfolio, strategic investment, and experience managing and operating critical infrastructure assets. META is a prominent toll road operator, controlling numerous critical routes for regional connectivity. In addition to toll roads, the corporation owns significant stakes in water treatment plants, port services, and telecommunications infrastructure. These conditions have made the company a full-service infrastructure provider. META''s ability to diversify across several industries within the infrastructure domain has enabled this company to manage risks, while at the same time capitalizing on numerous growth prospects.

META has delivered strong financial results. In 2023, the company projected revenues of around IDR2,5 trillion, indicating consistent development driven by its diverse business sectors. Despite a moderate net profit margin of roughly 8%, META has maintained a solid financial basis, with an asset base worth IDR12 trillion. Recent financial highlights include strategic investments in growing its toll road network and improving its water treatment facilities, which aim to sustain long-term revenue development.

The company's focus on sustainable development and infrastructure investment aligns with Indonesia's national development goals. META is well-positioned to maintain its growth trajectory and play a vital role in Indonesia's infrastructure sector, thereby contributing to the country's economic prosperity and improving public services.

PT Adhi Karya Tbk (ADHI)

PT Adhi Karya Tbk is a well-known Indonesian construction and engineering corporation founded on March 11, 1960, as a state-owned enterprise. First, the corporation focused on big construction projects throughout Indonesia, making substantial

contributions to the country's infrastructure development. An important milestone in its history was its first public offering in 2004, which marked its transition into a publicly traded corporation listed on the Indonesia Stock Exchange under the ticker symbol "ADHI".

ADHI's portfolio has grown over time to cover a variety of projects, including residential and commercial structures as well as large-scale infrastructure works including highways, railways, and water treatment plants. The company's evolution illustrates its transformation from a traditional construction company to a comprehensive infrastructure solutions provider.

ADHI has substantial authority in Indonesia's building and infrastructure sectors. The company's competitive advantages include experience in managing complicated projects, a diverse service offering, and strong government contacts, which allow it to gain high-profile contracts. ADHI's main business sectors are civil engineering, construction, property development, and infrastructure project investing. It has played an important role in major national projects such as the Light Rail Transit (LRT) systems and different toll road constructions, which are vital to improving Indonesia's transportation network and urban infrastructure.

ADHI has performed well financially despite the fierce competition in the construction business. In 2023, the company announced revenues of IDR17 trillion, demonstrating its strong market position and substantial project commitments. The company's net profit margin was around 5%, suggesting consistent profitability despite industry headwinds. ADHI's total assets were valued at almost IDR30 trillion, reflecting the company's ability to grow and invest heavily in new projects. Recent financial highlights include a focus on extending the project portfolio and improving operational efficiency to promote future development.

The company is dedicated to improving its financial performance and exploiting its significant experience to secure and complete large-scale infrastructure projects. ADHI continues to play an important role in Indonesia's infrastructure development, with plans to maintain its construction industry leadership and promote the country's economic growth.

ANALYSIS

Descriptive Statistics

Table 1 shows descriptive statistics of mean, most financial ratios decrease, Return on Asset remains stable, and Net Profit Margin increases. This is a sign that the M&A carried out by the five companies has been unprofitable after three years, which are then tested using the Wilcoxon and DEA tests.

Table 1. Descriptive statistics result in the company's ratios

Ratio of Company	N	Mean					
		t-3	t-2	t-1	t+1	t+2	t+3
Current Ratio	5	1,47	1,26	2,39	1,57	1,41	1,54
Cash Ratio	5	0,87	0,68	1,78	0,68	0,45	0,46
Debt Ratio	5	0,69	0,67	0,65	0,62	0,66	0,69
DER	5	2,97	2,63	2,62	1,80	1,93	2,46
ICR	5	24,63	22,84	11,06	6,32	3,70	3,13
FATO	5	16,54	15,88	10,59	7,42	7,98	10,49
TATO	5	0,63	0,56	0,51	0,48	0,42	0,46
ROA	5	0,04	0,04	0,04	0,05	0,04	0,03
ROE	5	0,17	0,17	0,16	0,12	0,09	0,09
NPM	5	0,05	0,11	0,11	0,13	0,13	0,09

Furthermore, Table 2 provides descriptive statistics for industry averages. The DEA is probably decreasing, which indicates that M&A will not improve company performance for three years after it is implemented.

Table 2. Descriptive statistics of industry average

Ratio of Industry Average	N	Mean		
		t+1	t+2	t+3
Current Ratio	5	1,20	1,10	1,04
Cash Ratio	5	0,36	0,33	0,23
Debt Ratio	5	0,69	0,71	0,76
DER	5	2,17	2,25	2,83
ICR	5	2,97	2,94	3,02
FATO	5	7,78	6,66	7,01
TATO	5	0,46	0,38	0,38
ROA	5	0,04	0,03	0,02
ROE	5	0,11	0,08	0,09
NPM	5	0,08	0,07	0,06

Inferential Analysis: Wilcoxon Signed Rank Test Result

This test compares the financial ratios of several Indonesian infrastructure companies before and after M&A. It aims to determine if significant differences are the results of M&A activities. Table 3 shows that they support insignificant results because of financial ratios. For results that are obtained above the significant level of 0.05 or more than 0.05, then H_{01} is accepted. The ratios include Current Ratio, Cash Ratio, Fixed Asset Turnover Ratio, Total Asset Turnover Ratio, Debt Ratio, Debt to Equity Ratio, Interest Coverage Ratio, Net Profit Margin, Return on Assets, and Return on Equity.

Table 3. Wilcoxon signed-rank test result

Ratio (x)	N	Mean	Std. Deviation	Z	Asymp. Sig. (2-tailed)
Current Ratio Before	5	1,71	1,38	-0,67	0,5
Current Ratio After	5	1,51	0,85		
Cash Ratio Before	5	1,11	1,71	-0,94	0,345
Cash Ratio After	5	0,53	0,49		
Fixed Asset Turnover Ratio (FATO) Before	5	14,34	10,77	-1,48	0,138
Fixed Asset Turnover Ratio (FATO) After	5	8,63	8,33		
Total Asset Turnover Ratio (TATO) Before	5	0,57	0,34	-1,6	0,109
Total Asset Turnover Ratio (TATO) After	5	0,45	0,24		
Debt Ratio Before	5	0,67	0,16	-0,68	0,498
Debt Ratio After	5	0,66	0,18		
Debt to Equity Ratio (DER) Before	5	2,74	1,73	-0,4	0,686
Debt to Equity Ratio (DER) After	5	2,06	1,18		
Interest Coverage Ratio (ICR) Before	5	19,51	29,76	-1,21	0,225
Interest Coverage Ratio (ICR) After	5	4,39	3,82		
Net Profit Margin (NPM) Before	5	0,09	0,04	-0,13	0,893
Net Profit Margin (NPM) After	5	0,12	0,09		
Return on Assets (ROA) Before	5	0,04	0,02	0	1
Return on Assets (ROA) After	5	0,04	0,02		
Return on Equity (ROE) Before	5	0,17	0,12	-1,1	0,273
Return on Equity (ROE) After	5	0,10	0,04		

Comparison of the Company's Financial Ratios with Industry Average

This study aims to determine whether M&A operations cause a company to score above its rival by using an industry cluster of firms that operate based on the weighted average principal within the same industry as the study company. The ratio of the sample company to the apple-to-apple comparison is then correlated with the outcome of that industry company.

Table 4. Mean comparison of ratio three years after M&A and industry

No	Ratio	Comparison with Industry Average	
		Higher Than Industry average	Lower Than Industry Average
1	Current Ratio	4 companies	1 Company
2	DER Ratio	3 companies	2 companies
3	Total Asset Turnover Ratio	2 companies	3 companies
4	Net Profit Margin Ratio	4 companies	1 Company
5	Return on Asset	4 companies	1 Company
6	Return on Equity	3 companies	2 companies

Tables 4, 5, and 6 suggest that if the comparison was made between the company's financial ratio after M&A with the industry average, the result is that most of the company's financial ratios are above the average, which in 6 (six) ratios, Current Ratio, DER Ratio, Total Asset Turnover Ratio, Net Profit Margin, Return on Asset, and Return on Equity, are the ratios with the majority number of companies that perform above industry average.

Only the Total Asset Turnover Ratio has a different result, i.e., the company mostly outperforms the industry average. This strengthens the assumption that in 3 (three) years, M&A does not improve the company's financial performance.

Table 5. Mean comparison of Current Ratio three years after M&A and industry average breakdown per ratio (cont'd)

Code	Sample Company	Current Ratio (x)			DER Ratio (x)			TATO Ratio (x)		
		Industry Average	After M&A	Difference	Industry Average	After M&A	Difference	Industry Average	After M&A	Difference
JSMR	PT Jasa Marga Tbk	1,12	0,65	-0,47	2,42	2,52	0,10	0,40	0,34	-0,06
WTON	PT Wijaya Karya Beton Tbk	1,20	1,36	0,16	2,05	0,69	-1,36	0,41	0,73	0,32
WSKT	PT Waskita Tbk	0,92	1,09	0,17	3,13	3,27	0,14	0,41	0,37	-0,04
META	PT Nusantara Infrastructure Tbk	1,20	3,01	1,81	2,05	0,88	-1,17	0,41	0,14	-0,27
ADHI	PT Adhi Karya Tbk	1,12	1,42	0,30	2,42	2,94	0,52	0,40	0,66	0,26

Table 6. Mean Comparison of Ratio 3 (three) Years After M&A and Industry Average Breakdown Per Ratio

Code	Sample Company	NPM Ratio (%)			ROA %			ROE %		
		Industry Average	After M&A	Difference	Industry Average	After M&A	Difference	Industry Average	After M&A	Difference
JSMR	PT Jasa Marga Tbk	0,07	0,10	0,03	2,94%	3,20%	0,26%	0,10	0,11	1,28%
WTON	PT Wijaya Karya Beton Tbk	0,08	0,08	0,00	3,15%	6,12%	2,98%	0,09	0,10	0,64%
WSKT	PT Waskita Tbk	0,06	0,07	0,01	2,52%	2,95%	0,43%	0,10	0,13	2,53%
META	PT Nusantara Infrastructure Tbk	0,08	0,29	0,21	3,15%	4,03%	0,88%	0,09	0,08	-1,67%
ADHI	PT Adhi Karya Tbk	0,07	0,05	-0,02	2,94%	2,79%	-0,15%	0,10	0,08	-1,84%

Company's financial ratio is lower than Industry Average

Company's financial ratio is higher than Industry Average

DEA Analysis

The researchers also conducted a Data Envelopment Analysis through the five major companies in the industry: PT Jasa Marga Tbk, PT Wijaya Karya Beton Tbk, PT Waskita Karya Tbk, PT Nusantara Infrastructure Tbk, and PT Adhi Karya Tbk. The calculations of the DEA analysis revealed that only one company has successfully increased its efficiency score after M&A, and that is PT Adhi Karya Tbk (see Table 7). The other four companies experience declining efficiency scores. For Adhi Karya, the efficiency score has increased by 0,019%. According to the company's financial statement and M&A process, Adhi Karya did merge with its subsidiary company so it makes sense that its fixed assets experienced tremendous growth while their synergy aligned.

Table 7. DEA comparison before and after M&A

Company	Year	Input 1 Fixed Asset	Input 2 Salary	Output 1 Revenue	Efficiency Score
JSMR	2012	422.506.867	1.085.623.357	9.070.219.074	
	2013	593.028.346	1.196.198.582	10.294.667.635	0,991
	2014	701.727.320	1.288.704.552	9.175.319.005	
	2015	913.842.793	1.585.759.184	9.848.242.050	
	2016	884.665.521	1.928.883.897	16.661.402.998	0,634
	2017	1.035.922.309	1.955.442.108	35.092.196.191	
WTON	2011	429.643.841	46.274.002	1.635.086.530	
	2012	584.605.241	57.956.089	2.030.596.831	0,948
	2013	1.012.106.939	88.911.003	2.643.724.434	
	2014	1.671.205.371	137.428.718	3.277.195.052	
	2015	1.997.514.941	184.859.486	2.652.622.140	0,869
	2016	2.223.141.399	207.697.090	3.481.731.506	
WSKT	2014	621.791.835	246.993.162	10.286.813.284	
	2015	1.923.143.995	290.631.919	14.152.752.847	0,966
	2016	3.013.846.252	427.464.463	23.788.322.626	
	2017	4.742.288.130	837.112.171	45.212.897.632	
	2018	7.091.121.159	1.034.852.971	48.788.950.838	0,871
	2019	8.663.216.063	786.179.050	31.387.389.629	
META	2011	1.194.180.331.161	20.076.134.264	232.000.095.750	
	2012	17.903.603.604	28.104.650.536	270.397.259.548	1
	2013	35.769.060.147	42.498.894.232	425.860.507.655	
	2014	120.066.714.671	83.756.469.535	518.377.770.555	
	2015	122.662.024.967	89.333.571.284	618.207.961.796	0,952
	2016	201.144.275.649	91.607.729.073	986.831.041.277	
ADHI	2012	187.437.135	148.773.789	7.627.702.794	
	2013	271.256.911	208.316.201	9.799.598.396	0,955
	2014	496.095.844	218.378.193	8.653.578.309	
	2015	895.346.084	237.726.765	9.389.570.098	
	2016	1.199.799.658	256.363.302	11.063.942.850	0,974
	2017	1.520.930.722	318.713.090	15.156.178.074	

The above table shows that JSMR's revenue grew exponentially after the acquisition for the following three years. However, the asset remained constant. The efficiency score found was -0,357, which indicates that the company did not utilize its fixed assets efficiently and that the synergy was not good after the acquisition. Another thing is that JSMR also accumulated a lot of debt after the acquisition. It also adds more expenses and costs for the company to grow. Thus, while FAT and TATO increase after the acquisition, there is not much difference since the liabilities also increase. This means the company must pay interest expenses and debt throughout the year.

The second company is WTON, a subsidiary of PT Wijaya Karya. WTON experienced a decrease in its efficiency score, for as much as -0,079, while the WTON fixed asset increased. The utilization of the fixed assets is not good. This is proven by the revenue that remained constant throughout the following three years of the acquisition and, again, the lack of synergy.

The third company on the line is WSKT (Waskita). The efficiency score and the acquisition have successfully added a lot of fixed assets to this company. However, the liabilities side of the company reveals a

tremendous increase and indicates that this company, at some point after the acquisition, is leveraged. Again, this causes the company to experience bottlenecks and force it to operate with a low-profit margin.

The next company, Nusantara Infrastructure, shows a lower efficiency score of -0,048. However, the liabilities and the fixed assets of this company grow together and increase revenue. The results show an increase in employee salaries, which might explain the decrease in efficiency scores in the company. Therefore, the company needs to cover it up with more revenue in the upcoming year. However, if the employee salaries keep increasing, the efficiency score will also decline further, thus leading the company to experience another bottleneck situation.

Further Reflection

Based on the results of average analysis, M&A activities have brought negative effects (some of them are small, but still negative) to within 3 (three) years, especially the cash ratio. After M&A, the cash ratio is directly reduced by one time, and the fixed assets increase. At the same time, the average current ratio decreases, ROE decreases, and TATO decreases, but ROA and debt ratio remain unchanged. This indicates that most of the performance is poor, and the company's efficiency is not high after the merger.

The result of the M&A of the different companies in infrastructure indicates that the activities were administered with no synergy. Therefore, the financial ratios statistically result in an insignificant difference. This might be related to the improper acquisition or target firm selection, as well as the acquiring company's lack of experience with M&A. Companies mostly employ outside (debt money) to finance firm operations and/or transactions in M&A activities. Funds used to finance M&A incur considerable expenditures, ensuring that the company's leverage remains constant.

Since the TATO of the companies in this research exceeds the industry average, companies can utilize their assets. Some use debt when doing the M&A, and there is a potential that other companies increase sales significantly. The fact implies that Indonesian infrastructure companies still face many challenges in increasing their efficiency since all of the companies lack financial efficiency.

The researchers found that the financial efficiency after M&A was not optimistic. The mean in Table 7 shows that the ICR is significantly reduced. The average Total Asset Turnover Ratio is smaller after the M&A than before the M&A. If Net sales are stable, most companies adjust and increase total assets. This M&A show that the incentive for M&A can be to make higher in fixed assets.

CONCLUSION

The following points mainly summarize the analysis and interpretation results:

1. Based on the Wilcoxon Signed Rank Test Result, M&A shows a considerable financial impact on these five companies with regard to the changes in fixed assets and ICR. Fixed assets increase, while at the same time, enterprises' long-term solvency weakens. Other internal financial ratios have changed but are not significant. The findings imply that after three years of M&A, the companies' financial performances still cannot improve statistically significantly.

2. M&A activities do not improve the companies' financial and efficiency performance, but more than 50% of the company's financial ratio exceeds industry financial ratios. Therefore, there is a chance for companies to improve their performance in the future.

3. In general, although the results of M&A in recent years have not had a great positive impact on financial performance, they meet the company's purpose of implementing M&A to increase fixed assets.

4. M&A activities reduce liquidity. This can be caused by M&A occupying a large amount of liquidity resources. Then, multiple interest protections should be significant to make the enterprise's long-term solvency more robust. Should the interest coverage ratio be too low, the security and stability of enterprise debt repayment would be at significant risk. To solve this problem, the merged company should consider reducing costs or increasing profits as much as possible.

5. As a part of our policy recommendations for State-Owned Enterprises (SOEs), before allowing infrastructure companies to engage in M&A, the government must consider several key considerations to ensure that these activities are beneficial to the economy, competitive, and aligned with national interests. These reflect alignment with the national goals, establishment of robust risk management frameworks to identify and mitigate potential risks associated with the M&A (such as financial, operational, and reputational risks) and establishment of mechanisms for ongoing monitoring and evaluation of the M&A's outcomes (in terms of the financial performance, operational efficiency, and strategic alignment).

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Reforming Public-Private Partnerships in Railway Services: Learning from the Jakarta Monorail Project Debacle

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ABSTRACT

Public-Private Partnerships (PPPs) offer a promising strategy for accelerating railway infrastructure development, yet they entail significant risks if not executed correctly. Indonesia has adopted PPPs since the 1990s, but their impact on railway services remains underexplored. This paper suggests improvements to Indonesia's railway PPP mechanism to improve effectiveness, efficiency, and service deliverability. It argues that the effectiveness of railway PPPs is hindered by the public sector's limited capacity and weak regulatory and institutional frameworks. The research employs a case study of the Jakarta Monorail project, terminated in 2015 after 11 years of problematic development. The research methods include literature reviews and a comparative analysis of the case with two prominent railway PPPs in other developing countries: the Bangkok Transit System in Thailand and the Delhi Mass Rapid Transit System Phase I in India. The findings lead to two key recommendations for the government: reorganizing the roles and coordination processes of key PPP agencies and establishing a continuous capacity-building scheme for PPP stakeholders. These recommendations may create a more supportive environment for PPPs, thereby increasing the likelihood of successful railway PPP implementation in Indonesia.

Keywords: Infrastructure; Public-private partnerships; Railway

ABSTRAK

Kerja sama Pemerintah dan Badan Usaha (KPBU) merupakan skema pembiayaan infrastruktur yang berpotensi mempercepat pembangunan infrastruktur kereta api namun dapat menimbulkan risiko signifikan jika tidak dilakukan dengan benar. Indonesia telah mengadopsi skema kerja sama pemerintah dan swasta sejak tahun 1990-an tetapi dampaknya terhadap layanan kereta api masih dipertanyakan. Oleh sebab itu, penelitian ini mengusulkan perbaikan mekanisme KPBU kereta api di Indonesia untuk meningkatkan efektivitas, efisiensi, dan keterjangkauan layanan. Penelitian ini melihat bahwa efektivitas KPBU kereta api masih ambigu karena kurangnya kapasitas Penanggung Jawab Proyek Kerja Sama (PJPK) dan lemahnya kerangka regulasi dan kelembagaan. Penelitian ini menggunakan studi kasus proyek Monorel Jakarta yang dihentikan pada tahun 2015 setelah mengalami permasalahan selama 11 tahun. Metode penelitian yang digunakan adalah tinjauan pustaka dan analisis komparatif antara kasus tersebut dengan KPBU kereta api terkemuka di dua negara berkembang: Bangkok Transit System di Thailand dan Delhi Mass Rapid Transit System Fase I di India. Penelitian menghasilkan dua rekomendasi pada pemerintah, yaitu menata ulang peran dan proses koordinasi lembaga kunci KPBU termasuk PJPK dan pihak swasta, serta membangun skema peningkatan kapasitas yang berkelanjutan bagi para pemangku kepentingan kunci KPBU. Rekomendasi ini dapat menciptakan lingkungan yang lebih mendukung bagi KPBU dan meningkatkan peluang keberhasilan pelaksanaan KPBU kereta api di Indonesia.

Kata Kunci: Infrastruktur; Kereta; KPBU

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INTRODUCTION

Public-Private Partnerships (PPPs) have been widely recognized as a global innovative infrastructure development strategy since the 1990s (Bovaird, 2010). In this context, PPPs involve cooperation between public and private entities through contractual agreements to deliver public services, improve service quality, and boost infrastructure investments (Alexandersson & Hulten, 2009). One of the key characteristics of PPPs is the risk transfer from the public to the private sector, which administers the project (Yang et al., 2017). It requires the public sector to have a good understanding of the overall concept of PPPs, particularly risk-sharing, since a lack of comprehension can lead to high-risk contracts that threaten public service delivery (Floyd et al., 2017). The paper aims to examine the effectiveness of PPPs in railway projects in Indonesia, identify critical success factors, and suggest improvements to the current system to enhance its implementation efficiency.

PPPs have been introduced in Indonesia since the New Order period under President Soeharto's rule, and they were initially used to finance roads and electricity in 1967. However, they became better known after his resignation (Noor, 2016). The regulation of PPPs was formalized in 1998 with the issuance of Presidential Decree No. 7/1998 on PPPs in Infrastructure Development (Sarana Multi Infrastruktur, 2021). The Minister of Public Works Decree No. 249/KPTS/1995 and DKI Governor Decree No. 1327/95 established one of the first municipal PPPs schemes in Indonesia, followed by the appointment of private operators to oversee clean water provision in DKI Jakarta (Nugroho, 2011).

In this context, Indonesia stipulated Presidential Regulation No. 67/2005, which was later replaced by Presidential Regulation No. 38/2015, on PPPs in Infrastructure Provision. According to the Japan International Cooperation Agency (JICA) (2012), one of Indonesia's PPP projects was the development of the Jakarta Monorail in cooperation with PT Jakarta Monorail and its consortium (JM), with an estimated value of IDR2,6 trillion. The project was aimed to address congestion issues and improve public transportation services. However, it was paused in 2008 due to financial and legal issues. After several attempts to revive the project and lengthy negotiations in 2013, the project was finally canceled by the Governor of Jakarta in 2015 following the consortium's failure to meet the city's proposed requirements (Hansen et al., 2018). The JM case has arguably become one of the most notable examples of PPP failure in Indonesia.

There have been few studies discussing railway PPPs in Indonesia. Most existing

research focuses on technical aspects, such as refinancing mechanisms (Adam et al., 2023) and the evaluation of the operation and maintenance phase (Rahman et al., 2019). This paper takes a broader perspective, examining how the current system can be improved to facilitate the implementation of PPPs in the railway sector. I will compare the institutional arrangements and capacities of two prominent railway projects in Asia, namely the Bangkok Transit System (BTS) in Thailand and the Delhi Mass Rapid Transit System (DMRTS) Phase I in India, with the case in Jakarta.

Based on the comparative analysis and various considerations, the plausible recommendations to the government are to restructure the roles and coordination mechanisms of the PPP key agencies and establish a capacity-building program for PPP key stakeholders. Implementing these recommendations may create an effective enabling environment for PPPs, increasing the likelihood of successful railway PPP implementation in emerging countries, particularly in Indonesia.

LITERATURE REVIEW

Monorail Project in Jakarta: An Overview

Jakarta's severe traffic congestion causes an annual economic loss of approximately IDR5,5 billion due to operating costs and travel time (Badan Perencanaan Pembangunan Nasional [Bappenas] and JICA, 2004). To address this issue, the city established the Study on Integrated Transportation Master Plan (SITRAMP) in 2004, recommending private sector involvement in public transport to reduce costs and improve service quality. Then, JM proposed a circular Jakarta monorail project through a Build-Operate-Transfer (BOT) Public-Private Partnership (PPP) in 2004, securing a 30-year concession with a possible 10-year extension (JICA, 2012).

Under the agreement, JM would finance and develop the monorail infrastructure, while the government would handle land provision without subsidizing construction (Oxford Business Group, 2007). The monorail was planned to span 29 km through business and commercial areas (Hansen et al., 2018). The project saw frequent changes in private entities, starting with MTrans in 2003 and then a joint venture between JM and Adhi Karya. Despite constructing 170 foundation pillars worth IDR190 billion, JM faced financial difficulties, leading to project suspension in 2007 and the abandonment of the pillars (Marbun, 2014; DetikFinance, 2014).

In 2013, the project was revived by the Governor of Jakarta, with JM at this time backed by Ortus Group from Singapore (Dewi, 2013). The new contract drafts allowed JM to earn revenue from advertisements and rental fees at around 30 stations ('Editorial: Risks', 2013). However, issues such as contractor bank statement failures and land-use changes arose (Investor Daily, 2015). The government set 15 requirements for JM, including a financial guarantee and a business plan, which JM could not meet, leading to the project's permanent termination and a debt of approximately $88 million to the government (Mcbeth, 2014).

In conclusion, this PPP encountered early termination during the construction phase due to significant legal and financial challenges. The following section discusses the potential benefits and drawbacks of several issues of PPP projects for railway infrastructure development, which is related to the JM case.

BTS Skytrain in Thailand

The BTS "Skytrain" in Bangkok arose from the Governor's frustration with the central government's inability to alleviate traffic congestion (Floyd et al., 2017). Development partners recommended a rail transit system to enhance transportation in outer areas and reduce city-center congestion. With costs exceeding $1 billion, the government turned to a 30-year Build-Operate-Transfer (BOT) scheme (Verougstraete & Enders, 2014). Developed by a Thai conglomerate linked to Hong Kong and financed by the International Finance Corporation (IFC), the construction lasted from 1990 to 1999. Despite challenges like the Asian economic crisis and route changes, the system opened in 1999 as a 37 km elevated metro, now serving about 600,000 passengers daily.

The BTS Skytrain is recognized as one of the successful railroad PPP cases, having navigated economic crises and delivered high-quality services despite numerous challenges (Allport et al., 2008; Kokkaew, 2015; Verougstraete & Enders, 2014). The Bangkok Metropolitan Administration (BMA) serves as the Government Contracting Agency (GCA) and is the exclusive government sponsor, holding significant authority in project decision-making and management (Allport et al., 2008). GCA is the key stakeholder providing the infrastructure, which is responsible for the preparation, operation, and monitoring of the PPP projects. It could be ministers, heads of institutions, or heads of regions (Kacaribu et al., 2019). BMA policy mandates that the concessionaire coordinate and negotiate funding and improvement plans directly with BMA, excluding the national government (Floyd et al., 2017).

One of the critical success factors for the BTS Skytrain was the clear and centralized authority of the BMA, which streamlined decision-making and reduced bureaucratic delays (Allport et al., 2008). Regulatory and institutional challenges were minimized by empowering local governments to handle the project independently (Floyd et al., 2017). In contrast, Jakarta's monorail project faced significant delays and eventual cancellation due to excessive central government involvement and lack of clear authority (Hansen et al., 2018). It led to financial and legal issues, highlighting the importance of a well-defined regulatory and institutional framework for PPP projects (Marbun, 2014).

Comparing the BTS Skytrain with Jakarta's monorail project underscores the need for a cohesive and empowered local governance structure in Indonesia to ensure the success of infrastructure projects (Allport et al., 2008; Floyd et al., 2017; Hansen et al., 2018; Marbun, 2014).

Delhi Mass Rapid Transit System Phase I in India

The Delhi Metro Rail Transit System (DMRTS) project has been highlighted by the Global Infrastructure Hub (2019) as a notable example of a successful public sector infrastructure initiative in India. It is India's second-largest metro system after Kolkata Metro, notable for its timely completion within budget and profitability without government subsidies (GIH, 2019). Covering Delhi and nearby areas like Gurugram and Noida, the extensive 405 km network was planned over four phases spanning 20 years.

Established as a 50:50 joint venture between the Government of India and that of Delhi in 1995, the Delhi Metro Rail Corporation

(DMRC) successfully launched Phase I, a 65 km segment costing $2,1 billion, in 2002. The project was primarily financed by the Japan International Cooperation Agency (JICA) and government funds. The timely and within-budget completion of DMRTS Phase I in 2002 was partly attributed to the involvement of international consultants and advisors from Japan, who significantly bolstered the project preparation capabilities of the GCA on a global scale.

This capacity building during the initial phase was crucial for the successful PPP projects implementation (GIH, 2019). International consultants and advisors from Japan enhanced the project preparation capabilities of the GCA, facilitating timely and within-budget completion of the metro system. This capacity building included expertise in project planning, financing strategies, and technical execution, crucial for navigating the complexities of infrastructure development (GIH, 2019).

Jakarta's monorail project had to adopt such capacity building efforts that contributed to its eventual failure. The project faced significant delays and cancellations due to financial and legal challenges exacerbated by fragmented responsibilities and inadequate local authority (Hansen et al., 2018; Marbun, 2014). The disparity underscores the importance of comprehensive capacity-building initiatives to empower government agencies in effectively managing PPP projects, ensuring better outcomes, and mitigating risks associated with large-scale infrastructure developments.

PPP Regulatory Framework in Indonesia

After the enactment of Presidential Regulation No. 67/2005, infrastructure development efforts waned during the second term of the Yudhoyono administration, exacerbated by an inadequate regulatory framework, leading to minimal progress until 2014 (Salim & Negara, 2018). Under the current Joko Widodo's administration, there is a renewed focus on addressing the annual economic losses of IDR65 trillion due to escalating traffic congestion in Jakarta (Singgih & Sipahutar, 2019). The government has prioritized private sector involvement in enhancing transportation infrastructure to mitigate urban congestion and improve connectivity, aligning with national development goals (Amindoni, 2016; Salim & Negara, 2018).

Presidential Regulation No. 38/2015 on PPPs in Infrastructure Provision has also spanned opportunities for private investment and provides more comprehensive guidance for stakeholders engaged in PPP projects (Tan & Tan, 2016; Widjaja, 2017). Despite solid political support, existing PPP regulations are perceived as inadequate during the implementation, particularly in the railway sector (Rahman et al., 2019). Notably, the risk of project termination due to uncertain political factors and inconsistent commitments remains a significant challenge for PPPs in Indonesia (Barker & Wibowo, 2019; Wibowo & Permana, 2015).

Furthermore, conflicts within the regulatory framework stem from overlapping regulations at both national and local levels, causing confusion among private investors and GCAs, which hinders their engagement in PPP projects (ADB, 2016; Lin, 2014; Salim & Negara, 2018). Moreover, the proliferation of PPP-related regulations complicates matters for national and local governments, resulting in inconsistent application of regulations across PPP projects (ADB, 2016). For example, delays in land acquisition for the Jakarta-Bandung

high-speed rail project are attributed to unclear and conflicting local and national regulations (Salim & Negara, 2018). Despite the recognized need for regulatory reform, it is acknowledged as a complex, long-term process requiring extensive collaboration (Kacaribu et al., 2019).

PPP Institutional Capacity in Indonesia

The Indonesia Infrastructure Guarantee Fund (IIGF) has highlighted key barriers to the adoption of PPP projects in Indonesia, including the need for dedicated commitment from GCAs and insufficient expertise in implementing PPP schemes effectively (Rahman et al., 2019). PPP implementation in Indonesia, for example, should pay more attention to the Value for Money (VfM) principle during feasibility assessments.

Capacity building for GCAs in Indonesia is crucial to address these challenges. GCAs play a vital role in facilitating PPP projects by overseeing procurement processes, conducting feasibility studies, and ensuring compliance with regulatory frameworks. However, capacity constraints within GCAs have been identified as a barrier to their effective operation (Wibowo & Permana, 2015). Strengthening the capacity of GCAs through training programs, knowledge exchange initiatives, and partnerships with international organizations could enhance their capability to manage PPP projects efficiently and transparently (ADB, 2016).

Probability of Success for Railway PPPs

Railway PPPs often need help to achieve their objectives in both developed and developing countries (Dehornoy, 2012; Rahman et al., 2019). Challenges typically arise during the operational phase due to high operation and maintenance costs, slow profit returns, and limited experience in both the public and private sectors. The risk of private entities abandoning unprofitable projects can undermine government credibility in public transportation (Alexandersson & Hulten, 2009). In contrast, Japan's successful commuter line privatization highlights the potential profitability of PPPs, driven by effective marketing strategies and strong public engagement (Wunderlich & Mayer, 2017). It underscores that the effectiveness of PPPs depends significantly on a country's commitment and strategic approach.

Additionally, the monopolistic nature of the transport sector (Transport and ICT Unit, 2017) and the 15-year history of rail monopolization by the Indonesian Railway Company have resulted in a heavily regulated rail infrastructure (Widyanto & Malkhamah, 2013). Despite the private sector being allowed to invest in railway infrastructure since the enactment of the Railway Law in 2007, the regulations supporting such investments have not been helpful to trigger private sector participation.

DISCUSSION

Key Challenges: Government Agencies' Coordination and Capacity Issues

One of the factors hindering the success of PPP projects is the lack of coordination within the central government and between local and national governments (ADB, 2016; Purbo et al., 2019; Wibowo & Permana, 2015). With regards to PPPs, various institutions play different roles, such as:

1. PPPs Joint Office led by Bappenas, which comprises several institutions to ensure intense coordination across agencies in

PPPs preparation and implementation (Global Infrastructure Hub [GIH], 2019);
2. The Indonesia Infrastructure Guarantee Fund (IIGF), which handles the government financial guarantee to tackle political risks issues in PPPs (World Bank, 2019);
3. PPPs Unit under the Ministry of Finance (MoF) to assist GCAs in preparing the feasibility studies and contractual documents until they reach the final agreement (Salim & Negara, 2018);

However, since some of these various PPP bodies overlap in their responsibilities, they need help to coordinate in a way that results in high-quality PPPs (Salim & Negara, 2018; World Bank, 2019, GIH, 2019). Moreover, PPP adoption in Indonesia has also been significantly hampered by insufficient public sector technical capacity (Purbo et al., 2019; Rahman et al., 2019; Wibowo & Permana, 2015).

Since many railway PPPs are conducted locally, the GCAs must take into consideration the local context and value when designing PPPs (Barker & Wibowo, 2019). GCAs and state-owned enterprises (SOEs) should also improve their institutional capacities to keep up with the rapidly growing demands of the PPPs.

POLICY RECOMMENDATIONS

The JM case, which failed to achieve financial close despite prolonged negotiations, exemplifies a common issue in Indonesian PPPs projects where relatively few reach contract finalization (Lin, 2014). This situation prompted reforms in the 2015 PPPs Regulation, particularly requiring competitive tendering for unsolicited proposals and establishing several institutions to oversee PPPs (Bappenas, 2019).

Despite these reforms, it is noteworthy that Indonesia has only managed one railway project funded through PPPs, namely the Makassar-Parepare Railway (ADB, 2020). Therefore, the following reforms remain crucially necessary.

Provide Sustainable Capacity Building for GCAs

This paper recommends establishing a capacity-building mechanism for GCAs to address institutional deficiencies in PPPs' implementation. Enhancing GCAs' skills in identifying, evaluating, structuring, tendering, managing, and monitoring PPP projects is crucial for success (Foster Infrastructure, 2016). Turbo et al. (2019) emphasize the need for technical training programs tailored to local contexts to improve PPP design.

India's DMRTS case which utilized international consultants to strengthen GCA capacity in project preparation (GIH, 2019), for example, is a worth noting initiative. In Indonesia, despite efforts by the PPPs Joint Office to build stakeholder capacity, challenges persist mainly due to staff turnovers and inadequate resources (Kacaribu et al., 2019). The PPPs Joint Office needs to establish sustainable training programs by collaborating with academics and institutions (nationally or internationally) to enhance GCA capabilities effectively.

Moreover, incorporating VfM concepts into PPPs' decision-making, as advocated by Bappenas (2019), will improve the public sector's ability to achieve competitiveness and effectiveness in partnering with the private sector.

Restructuring the Institutional Framework

Drawing from Thailand's BTS Skytrain PPPs, which share similarities with Indonesia's rail sector in governance and coordination challenges (Allport et al., 2008), decentralizing authority to local agencies like BMA could serve as a model. BMA's direct oversight and flexible decision-making have contributed to successful PPP outcomes (Floyd et al., 2017). This approach suggests that empowering GCA could similarly enhance project performance and responsiveness, benefiting from local insights and streamlined decision-making.

This paper suggests enhancing the authority of GCA to improve PPP implementation, whereas JM's project involved multiple parties, including significant central government participation, is also seen as potentially problematic (Allport et al., 2008). According to Higton (2005), successful PPPs require GCAs to focus on stable, fair, and detailed contracts to prevent frequent changes. Reforming the roles and responsibilities under the 2015 PPPs regulation could empower the GCA to select suitable concessionaires and adapt projects to local needs more effectively. They can also be more agile in their decisions.

Simplifying the flow among numerous agencies is also crucial to streamline coordination in PPPs. In the BTS case, the lack of national and local cooperation led to the central government only supervising the project (Mandri-Perrott, 2010). Effective coordination between the local and national governments is essential to prevent regulatory conflicts. The PPPs Joint Office can enhance coordination by publishing a standard operating method for all participants, reducing miscommunication and conflicting policies, and expediting negotiations, thus ensuring smoother railway PPP preparation.

CONCLUSION

PPPs can improve public service delivery efficiency and effectiveness, but implementing them in railways is challenging in many countries, especially developing countries like Indonesia. The JM case highlights issues such as vague regulations and insufficient public sector capabilities, leading to non-compliant private sectors and financial losses. To manage PPPs in public transport, enhancing public authorities' skills and establishing robust frameworks are crucial. Reforms should focus on supporting GCA's capacity, granting more authority to GCAs in PPP management, restructuring the institutional framework, and improving coordination mechanisms. These steps can create a better environment for successful railway PPPs in developing countries.

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Regional Economic Agglomeration and Trans-Sumatra Toll Road Development: A Network and Spatial Review

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ABSTRACT

Road and transportation networks play a crucial role in interregional connections. One of the key development programs initiated during President Jokowi's presidency in Indonesia is aimed at improving interregional connectivity. In Sumatra, the National Strategic Project *(Program Strategis Nasional/PSN)* for the construction of the Trans-Sumatra Toll Road has been underway since 2014. After a decade of development, it is essential to evaluate the impact of this infrastructure on the region's agglomeration to inform future development policies. This paper reviews the changes in network structures and economic activities as influenced by the construction of the Trans-Sumatra Toll Roads. It also seeks to predict the future development of agglomeration and economic activities. The study employs regional and city planning methodologies, including space syntax, fractal dimension analysis, and cluster analysis. The findings indicate that the construction of the Trans-Sumatra Toll Road has significantly enhanced connectivity and accessibility, increased the gravitational value of the territory, and reduced the load on existing roads. Moreover, the development of toll roads has led to the growth of new economic centers, which eventually resulted in the formation of four major agglomeration regions.

Keywords: Economic agglomeration; Policy evaluation; Road network; Space Syntax

ABSTRAK

Jaringan jalan dan transportasi memiliki peran penting dalam pengembangan koneksi antarwilayah. Salah satu program pembangunan yang dilakukan selama masa kepresidenan Jokowi di Indonesia adalah peningkatan konektivitas antarwilayah. Di Sumatra, pembangunan Proyek Strategis Nasional (PSN) Jalan Tol Trans-Sumatra telah berlangsung sejak 2014. Setelah melewati 10 tahun target pembangunannya, evaluasi perlu dilakukan untuk mengukur sejauh mana pembangunan ini berdampak pada aglomerasi wilayah sehingga hasilnya dapat menjadi dasar kebijakan untuk rencana pembangunan masa depan. Artikel ini bertujuan untuk mengkaji perubahan dalam struktur jaringan dan aktivitas ekonomi yang disebabkan oleh pembangunan Jalan Tol Trans-Sumatra. Artikel ini juga hendak memprediksi perkembangan aglomerasi dan aktivitas ekonomi di masa depan. Cabang keilmuan perencanaan kota dan wilayah digunakan sebagai dasar untuk metode penghitungan, termasuk sintaks ruang, dimensi fraktal, dan analisis klaster. Temuan penelitian menunjukkan bahwa pembangunan Jalan Tol Trans-Sumatra mampu meningkatkan nilai konektivitas dan aksesibilitas secara signifikan, meningkatkan nilai gravitasi wilayah, dan mengurangi beban pada jalan eksisting Pembangunan jalan tol juga memantik pertumbuhan pusat-pusat aktivitas baru, yang pada akhirnya membentuk empat wilayah aglomerasi utama.

Kata Kunci: Aglomerasi ekonomi; Evaluasi kebijakan; Jaringan jalan; Sintaks ruang

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INTRODUCTION

Under President Joko Widodo's leadership, Indonesia has prioritized on infrastructure development, allocating around IDR 3,309 trillion to various projects over eight years. A notable shift in strategy has expanded the focus from primarily Java-centric projects to a broader geographic regions, including Sumatra. Among these initiatives, the Trans-Sumatra Toll Road stands out, prominently featured in the 2020-2024 National Medium-Term Development Plan (RPJMN) and Presidential Regulation Number 109 of 2020 as a major project (Peraturan Presiden Republik Indonesia Nomor 18 Tahun 2020 Tentang Rencana Pembangunan Jangka Menengah Nasional 2020-2024, 2020).

Although the Trans-Sumatra Toll Road is planned to extend 2,800 km, only 547 km had been completed as of 2023. This includes critical segments connecting major urban and industrial centers across the island (Kementerian Pekerjaan Umum dan Perumahan Rakyat, 2016). The ongoing construction aims to significantly reduce travel times—from 48 to 30 hours between Lampung and Aceh—and to spur the development of industrial and tourism sectors. This infrastructure is crucial for enhancing connectivity between the eastern and western corridors of the island, promising profound economic impacts on the region (Berechman, 1994; Cervero, 2009; Closs & Bolumole, 2015; Hou, 2022).

The Indonesian government's commitment to expanding the toll road network reflects a broader strategy to enhance national connectivity and foster economic growth. Research supports the role of transportation infrastructure in promoting urbanization and economic agglomeration, with positive effects on economic activity and integration within and between urban areas (Berechman, 1994; Chatman & Noland, 2011; Vickerman, 2018; Wei et al., 2022; Ye et al., 2018). Infrastructure not only supports local economies but also facilitates broader regional economic systems, emphasizing the importance of interconnected economic activities and linkages between diverse urban and regional areas across Indonesia (Tao et al., 2020; Wang et al., 2022).

Numerous studies globally have explored the externalities arising from network development on economic agglomeration, yet many overlook the impact of such networks on shifting economic centers and regional growth (Ren et al., 2022). Specific to the Trans-Sumatra Toll Road, while the potential benefits and risks have been extensively discussed, there remains a significant gap in quantitative research assessing its direct impacts on accessibility, connectivity, economic agglomeration, and

regional economic growth. This study aims to bridge this gap by integrating three main bodies of literature—transportation infrastructure networks, economic agglomeration, and economic growth—within the framework of regional and urban planning.

The research utilizes the Spatial Design Network Analysis (SDNA) approach, employing algorithms such as Degree of Centrality, Closeness, Network Gravity, and Betweenness Centrality to examine changes in connectivity, accessibility, and transportation infrastructure load across Sumatra (Cooper & Chiaradia, 2020; He et al., 2019). It also incorporates a fractal dimension approach to quantify the level and spatial patterns of economic agglomeration prompted by the construction of the Trans-Sumatra Toll Road, specifically looking at how street intersections contribute to economic clustering (Afrianto, 2023; Kalpana et al., 2021; Shen, 2002). Furthermore, future economic activity centers are projected using night satellite imagery to simulate changes in economic dynamics. These methodologies not only provide a detailed understanding of the economic impacts of the Trans-Sumatra Toll Road but also contribute innovative approaches to regional planning, utilizing big data to enhance the precision of economic and developmental forecasts in Sumatra.

THEORETICAL FRAMEWORK

Connectivity and Accessibility

Networks, as spatial organizational systems, interlink cities and regions through economic and social bonds, generating externalities by integrating and synergizing connected nodes across two key dimensions: the material, which includes tangible infrastructure such as roads, railways, and communication systems, and the non-material, encompassing intangible flows and spatial relationships such as political cooperation and innovation among cities (Tao et al., 2020).

The essence of these networks lies in their connectivity, characterized by interconnected nodes—individuals, companies, cities, and states—that reflect the strength of their relational bonds (Jiao et al., 2020; The World Bank, 2019). Accessibility, on the other hand, relates to the opportunities for individuals to engage in various activities within these networks (Somenahalli et al., 2016). The development of transportation infrastructure plays a crucial role in enhancing both connectivity and accessibility. It profoundly impacts sustainable land use patterns by driving urban expansion, influencing city growth, and affecting land and property prices, thereby significantly reshaping urban and regional landscapes (Song et al., 2012; Sahu & Verma, 2022).

Economic Impacts and Economic Agglomeration Effects of Enhanced Connectivity, Accessibility, and Activity Systems

The development of transportation infrastructure introduces externalities that influence spatial dynamics across cities and regions, potentially driving economic growth at national, regional, and municipal levels (Tao et al., 2020; Weisbrod & Alstadt, 2007; Sahu & Verma, 2022; Tan et al., 2022; Verma et al., 2013; Xie et al., 2017). Such advancements facilitate economic expansion by reducing travel time, lowering travel costs, enhancing the mobility of production factors, and improving overall accessibility and connectivity (Chen & Haynes, 2017; Jiao et al., 2014; Olsson,

2009; The World Bank, 2019). The resultant economic impacts manifest as both immediate and long-term effects at the macro level (Chakrabarti, 2018; Chen & Haynes, 2017; Jia et al., 2017).

As illustrated in Figure 1, these effects can be categorized into direct and indirect impacts. Direct impacts include observable benefits such as travel time and cost savings, environmental improvements, reduced accidents, and job creation from new projects. Indirect impacts, however, emerge from the cascading effects of these direct benefits and encompass increased economic concentration and specialization (Sahu & Verma, 2022). Economic agglomeration, as described by Graham, results from the spatial concentration of economic activities, with its scale influenced by enhanced accessibility and connectivity brought about by infrastructure development (Graham, 2008). Thus, this infrastructure development not only directly affects economic metrics but also induces broader spatial and connectivity-based impacts that shape regional economic landscapes.

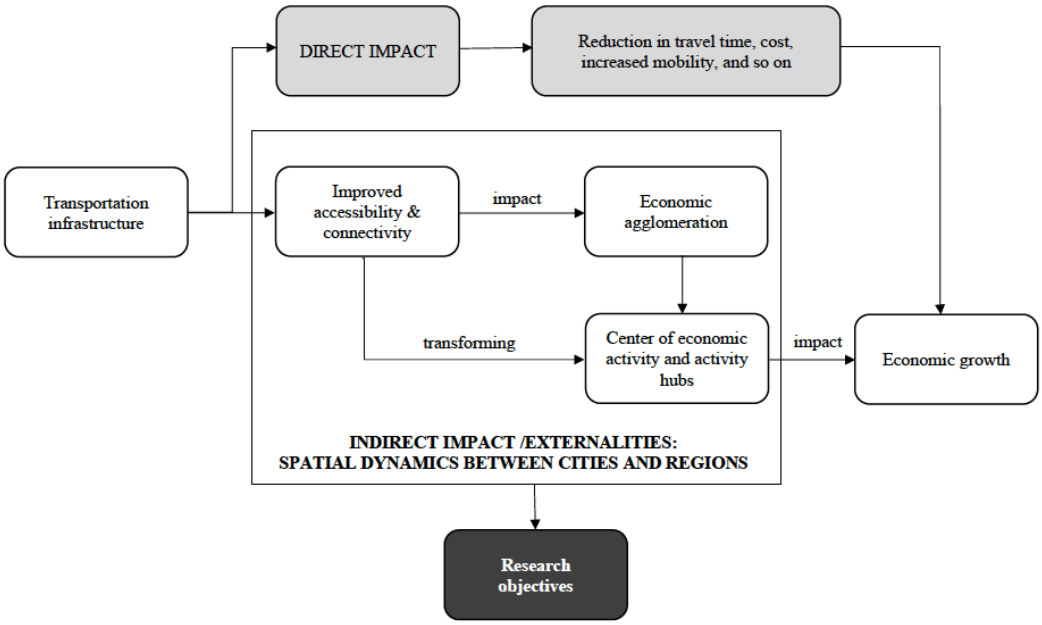

Figure 1. Conceptual frameworks

METHODOLOGY

Research Design

Economic transformation involves significant changes to the economic structure and direction, with the goals of sustainable growth and societal welfare enhancement. Central to this transformation is governmental policy, which is a focal point of research analyzing the National Strategic Project (PSN) of the Trans-Sumatra Toll Road Network development. Initiated in 2015, the PSN has reshaped Sumatra's spatial layout, with an aim for completion in 2024. This study evaluates three temporal states of Sumatra's road network: the pre-PSN in 2013, the current state in 2022 reflecting PSN progress, and the projected state post-completion in 2024. It assesses connectivity, potential agglomeration, and future economic activities.

Spatial Design Network Analysis, based on Space Syntax, is used to evaluate regional connectivity and accessibility. The Cluster

analysis, with Density-Based Spatial Clustering of Applications with Noise (DBSCAN) and Fractal Dimension analysis for road intersection distances, assesses the PSN's impact on economic clustering. The study also employs correlation analysis between Tight-Time Light (NTL) satellite imagery and Gross Regional Domestic Product (GRDP) to estimate economic activity. A high correlation suggests that NTL can serve as a proxy for GRDP to predict economic outcomes in 2024 upon the PSN's full realization, as detailed in Figure 2.

The entire analysis process was conducted using several software tools, including Microsoft Excel for correlation analysis, Quantum Geographic Information System (QGIS) for data preparation, the SDNA plug-in for SDNA analysis, the DBSCAN Toolbox for clustering analysis, and Fractalyze 3.0 for generating fractal dimension measurements.

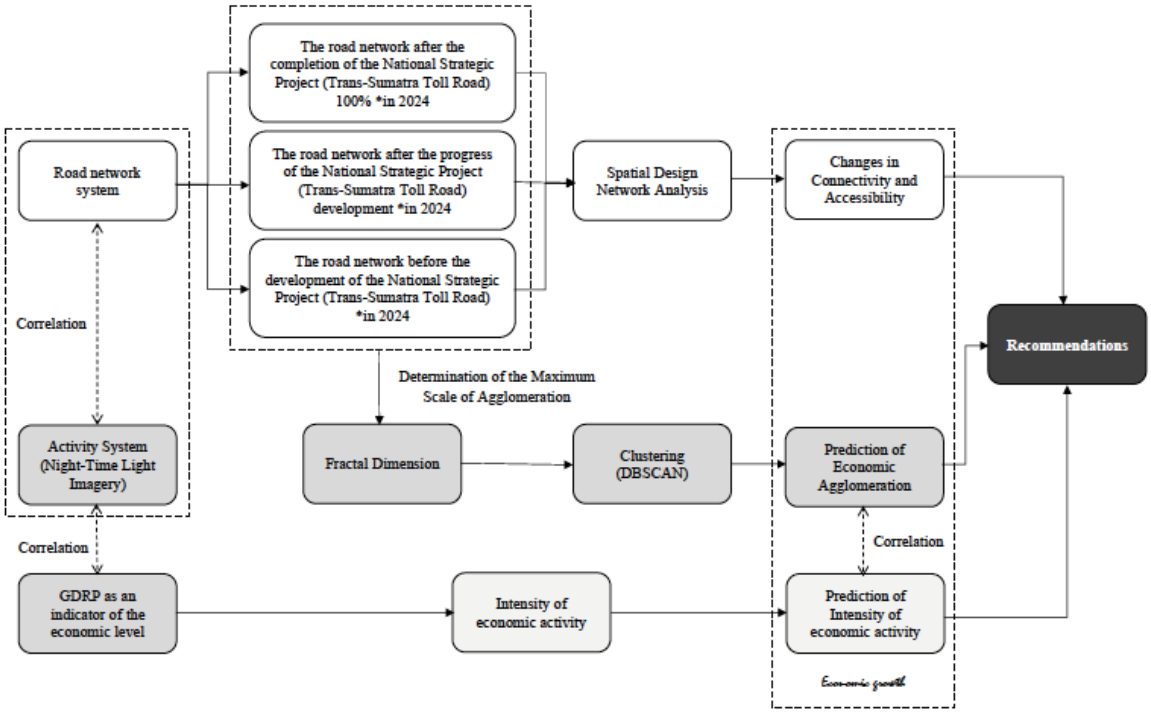

Figure 2. Research frameworks

Data and Data Source

This study involves three analytical concepts that necessitate fairly complex data. The fundamental data required includes information on administrative boundaries. Since network analysis requires data in the form of continuous and uninterrupted networks, the administrative boundaries of Sumatra Island in the mainland area are utilized. Furthermore, to conduct analyses related to accessibility, connectivity, and agglomeration, data on road networks at three different time points are necessary. Additionally, to analyze the intensity of economic activities, Night-Time Satellite imagery and GRDP data for each province in Sumatra are required. Detailed information regarding the research data is elaborated further in the subsequent sections (see Table 1).

Table 1. Research data

No	Type	Sources	Data Acquisition
1	Administrative boundary	Indonesian base map (Indonesian Geospatial Information Agency portal)	August 2023
2	The road network condition before the PSN in 2013	OpenStreetMap data, downloaded from the historical data of Geofabrik	Access Time: August 13, 2023, 9:10 am
3	The road network condition in 2022	Open StreetMap data, downloaded by Plugin QuickOSM QGIS	Access Time: August 13, 2023, 12:00 am
4	The plan for the National Strategic Project (PSN) of the Trans-Sumatra Toll Road	National Mid-Term Development Plan 2020-2024	
5	Projection of the completion of the Trans-Sumatra Toll Road PSN road network (by the end of year 2024)	Data number 3 is processed by incorporating the plan for the Trans-Sumatra Toll Road PSN	Data processed
6	Gross Regional Domestic Product (GRDP)	Central Bureau of Statistics (in each province)	August 2023
7	Night-Time Light (NTL) satellite image	Figshare dataset Harmonization of DMSP and VIIRS Night-Time Light data	Access Time: August 9, 2023, 12:00 am

Source: Researcher (2023)

This study examines the condition of the road network prior to the implementation of the National Strategic Plan (PSN) for the Trans-Sumatra Toll Road, using 2013 as the benchmark year. This initiative, which is a critical component of the 2020-2024 National Mid-Term Development Plan, began construction in 2015 with the goal of expanding the toll road network by an additional 2,031 kilometers by 2024. For a thorough comparative analysis, historical data from 2013 serves as the baseline. To ensure comprehensive analysis, all road network data in shapefile (*.shp) format is meticulously processed to fit the analytical framework. The SDNA and DBSCAN cluster analysis are conducted using the QGIS mapping tool. Meanwhile, the fractal dimension is calculated using Fractalyse, a Java-based software, to elucidate complex patterns of road network growth and its implications for regional development and economic agglomeration. This rigorous methodological approach allows for a detailed assessment of the PSN's impact on the Trans-Sumatra Toll Road, providing insights into the transformative effects of this large-scale infrastructure project.

Analysis Techniques

This research employs three core analytical methods: SDNA, Fractal Dimension Analysis, and Cluster Analysis. SDNA, a graph theory-based spatial configuration analysis, extends beyond the quantitative measures of space syntax, facilitating large-scale network analysis with more robust and accessible data (Cooper & Chiaradia, 2020; He et al., 2019). It is pivotal for assessing the road networks of Sumatra Island, employing algorithms such as Degree of Centrality to indicate network reach, Closeness and Gravity to locate central nodes based on shortest path accessibility, and Betweenness Centrality to highlight frequently chosen routes. These metrics help establish the economic potential of an area through its connectivity and accessibility (Yamu et al., 2021).

Fractal Dimension analysis draws on the concept that natural and urban forms, despite their apparent irregularity, maintain consistent patterns across scales. This concept, aided by GIS technologies and digital mapping, allows the study of urban agglomeration by identifying fractal patterns within city structures. Fractalyse-3.0, utilizing the Box Counting method, helps to analyze the merging processes of growth poles in cities or regions, which is then used to determine the distances for the subsequent DBSCAN cluster analysis.

DBSCAN, a density-based clustering technique, excels in identifying clusters by expanding from high-density core points and integrating neighbouring points, setting apart noise from significant data points (Suthar et al., 2013). This method requires the specification of an epsilon value to define the distance parameter for modeling density. By applying DBSCAN with the distances derived from fractal dimension numbers, this study delineates areas of economic agglomeration. This approach enables a multi-faceted analysis of changes in spatial structures and their economic implications over different phases of road network development in Sumatra.

RESULTS

This section elaborates on the research findings, commencing with the presentation of data on the development of road networks and intersections. The relationships between the studied elements are examined, followed by network and agglomeration analysis, and concluded with forward predictions.

Development of the Road and Intersection Network

As a foundation for analysis and discussion, data is presented on the condition of road network development and intersections. The data includes road length, average length of road sections, and the number of road segments. For intersections, the presented data encompasses the number of intersections and the average branching of roads at each intersection point.

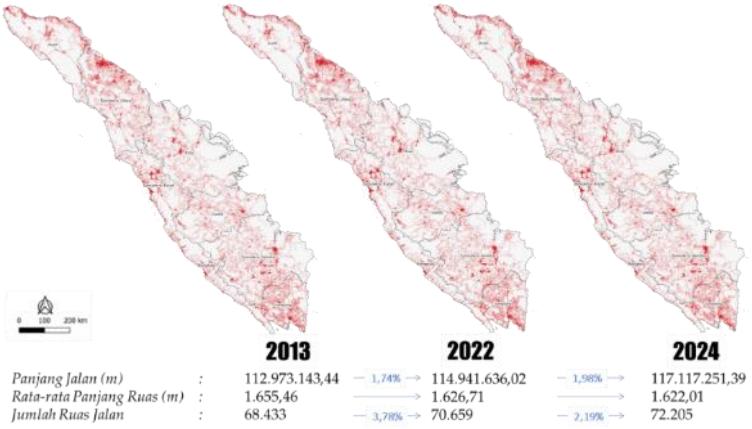

Figure 3. Road network data

Figure 3 shows the findings derived from the network data. The data for the year 2013 reveals a total of 68,433 road segments spanning 112,973 km, with an average length of 1,655.46 meters. By 2022, Sumatra had a total of 70,659 road segments with a total length of 114,941 km and an average length of 1,626.71 meters per road segment. This data differential shows an increment of 2,226 segments and an additional road length of 1,968 km between 2013 and 2022. According to the data processing outcomes,

in 2024 after the completion of the PSN road construction, Sumatra's road network will span 117,117 km with a total of 72,205 road segments. Comparing the existing 2022 network to the projected 2024 scenario upon PSN completion indicates a 1.98% increase in road length and a 2.19% increase in the number of road segments.

The road network entails extraction at each road intersection to depict them as aggregation nodes, with the roads forming links connecting these nodes. As per the data processing results shown in Figure 4, the number of intersections (nodes) in Sumatra was 41,873 units in 2013, which increased to 43,307 by 2022, and is predicted to rise further to 44,085 units by 2024 upon completion of the PSN road. This represents a 3.42% increase from 2013 to 2022, followed by a 1.08% rise in 2024. The average number of branches at each intersection was 3.097 in 2013, increasing to 3.109 in 2022, with predicted to rise further to 3.123 by 2024.

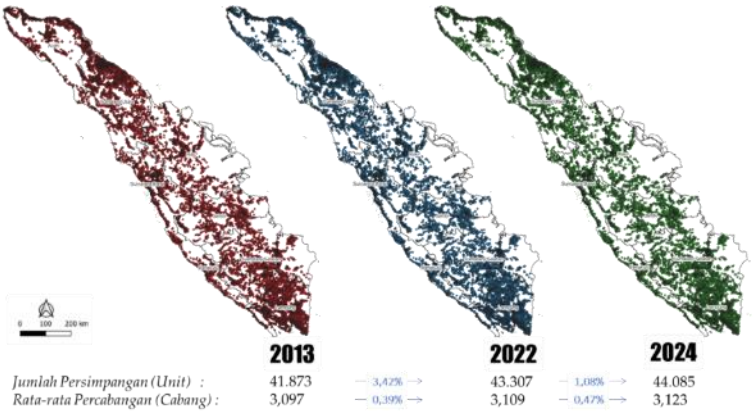

Figure 4. The processing of road network data for SDNA

The Relationship between Night-Time Light Imagery (NTL) and Gross Domestic Regional Product (GDRP)

NTL represents light intensity captured by satellites during nocturnal hours. NTL finds its appropriate application across various research domains, ranging from urban morphology (Afrianto et al., 2023), city size analysis (Ding et al., 2022), assessment of urban vitality (Zhou et al., 2023), and evaluation of urban diversification (Zhang et al., 2022). The intensity of light in NTL images correlates significantly with economic indicators such as GRDP (Afrianto, 2022). The higher the level of human activity, the higher the intensity of light captured in the NTL images. Additionally, higher levels of human activity are typically accompanied by a stronger economy. Therefore, NTL serves as a proxy for GRDP. It offers a spatial visualization of regional economic dynamics. Unlike GRDP data, which is typically tabular, NTL data is raster-based and easily spatialized.

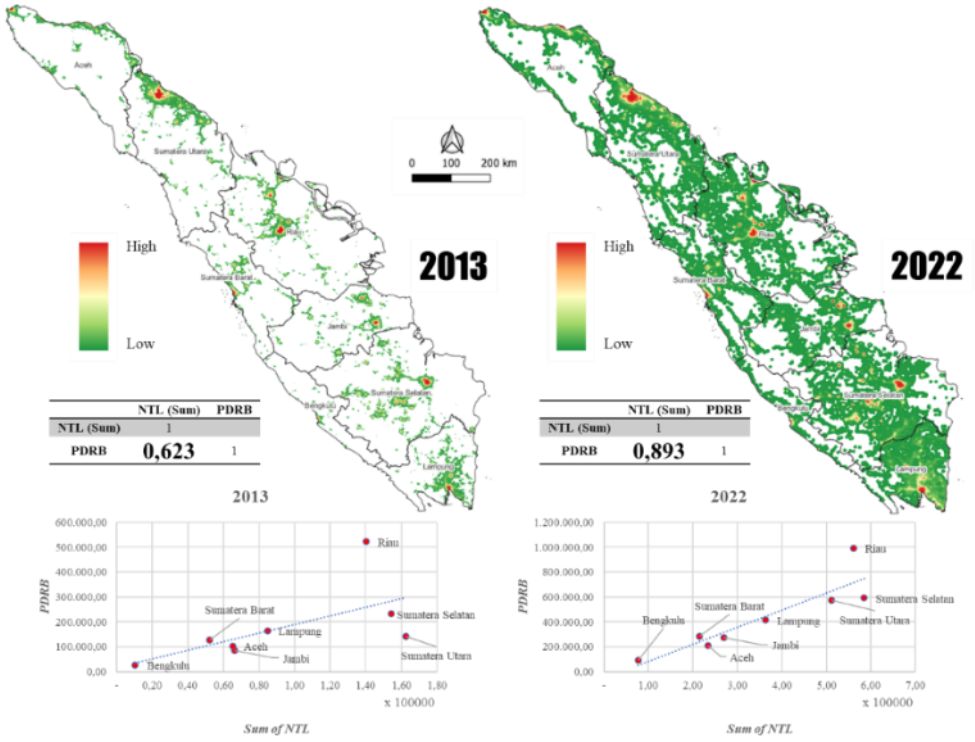

Figure 5. Night-time light (NTL) imagery and its correlation with GDRP

Figure 5 displays the NTL imagery of Sumatra Island in 2013 and 2022. In the 2013 image, high light intensity is only confined to urban centers within each province. However, in 2022, the NTL image indicates a significant increase in light intensity across the entire Sumatra Island, no longer concentrated in a single urban point in each province.

The structure of GRDP across Sumatra Island shows minimal change between 2013 and 2022. The Province of Riau consistently records the highest GRDP, while Bengkulu exhibits the lowest. These GRDP values correlate positively with the NTL light intensity across Sumatra Island. The correlation coefficients between NTL imagery and GRDP reflect a significant increase, rising from 0.623 in 2013 to 0.893 in 2022. Therefore, NTL imagery can serve as a spatial proxy for economic activity and can be effectively integrated into further road network analyses to evaluate the degree of their relationship.

The Relationship between Road Networks and Night-Time Light Imagery (NTL)

This study employs NTL as a spatial proxy to represent the economic indicator of GRDP. The relationship analysis on road networks includes their characteristics (number of road segments, length, intersections, and average branching ratio) and the network characteristics analyzed through space syntax.

Initially, the investigation focuses on the correlation between road network characteristics and NTL. The road network characteristics shows a strong correlation with NTL, which serves as a proxy for the economic sector. Before the construction of the Trans-Sumatra Toll Road in 2013, the total road length exhibited the strongest association with economic activity. However, by 2022, this relationship had shifted, with the average branching ratio emerging as the attribute most closely linked to economic activity.

Table 2. Road network's correlation with NTL in 2013

	Number of Segments	**Road Length**	**Number of Intersections**	**Average Branching Ratio**	**NTL (Sum)**
Number of segments	1				
Road length	0,947	1			
Number of intersections	0,999	0,937	1		
Average Branching Ratio	0,386	0,579	0,353	1	
NTL (Sum)	0,763	**0,906**	0,746	0,787	1

Source: Researcher (2023)

Table 3. Road network's correlation with NTL in 2022

	Number of Segments	**Road Length**	**Number of Intersections**	**Average Branching Ratio**	**NTL (Sum)**
Number of segments	1				
Road length	0,944	1			
Number of intersections	0,999	0,935	1		
Average Branching Ratio	0,551	0,735	0,526	1	
NTL (Sum)	0,642	0,830	0,623	**0,938**	1

Source: Researcher (2023)

The second relationship is between network characteristics and NTL. There are differences in the relationship between 2013 and 2022 as presented in Table 4 and Table 5. Prior to the construction of the toll road in 2013, the gravity algorithm (network attraction) and betweenness (road loading) demonstrated the strongest correlations with economic activity. However, by 2022, following the toll road completion, connectivity and accessibility emerged as the most strongly related factors. The correlations between SDNA algorithms and NTL values are presented in the tables below.

Table 4. SDNA result's correlation with NTL in 2013

	Connectivity	Closeness	Gravity	Betweenness	NTL (Sum)
Conn	1				
Closeness	-0,640	1			
Gravity	0,399	-0,595	1		
Betweenness	0,414	-0,726	0,539	1	
NTL (Sum)	0,538	-0,673	**0,866**	**0,707**	1

Source: Researcher (2023)

Table 5. SDNA result's correlation with NTL in 2013

	Connectivity	Closeness	Gravity	Betweenness	NTL (Sum)
Conn	1				
Closeness	-0,626	1			
Gravity	0,608	-0,593	1		
Betweenness	0,223	-0,621	0,146	1	
NTL (Sum)	**0,719**	**-0,749**	**0,754**	0,593	1

Source: Researcher (2023)

The correlation between SDNA algorithms and NTL, which serves as an economic proxy, shows a strong relationship both in 2013 and 2022. All algorithms have values above 0.6 except for connectivity in 2013 and betweenness in 2022. The negative values of closeness indicate an inverse relationship with NTL, consistent with closeness analysis where lower closeness values indicate higher accessibility and tighter integration. This strong relationship can be used to depict the NTL values or economic sector proxy (PDRB) in the SDNA results for 2024.

DISCUSSION

Spatial Design Network Analysis (SDNA)

The road network analysis was conducted using SDNA. The road network in Sumatra shows an increasing connectivity value (Figure 6) from 2013 to the projected year of 2024 upon the completion of the PSN. The highest connectivity value, indicated in red, is observed in the 2024 network, connecting Sumatra Island from Lampung to Aceh into a single network. Meanwhile, the provinces of West Sumatra and Bengkulu only have lateral red connecting lines without directly being linked to the main roads.

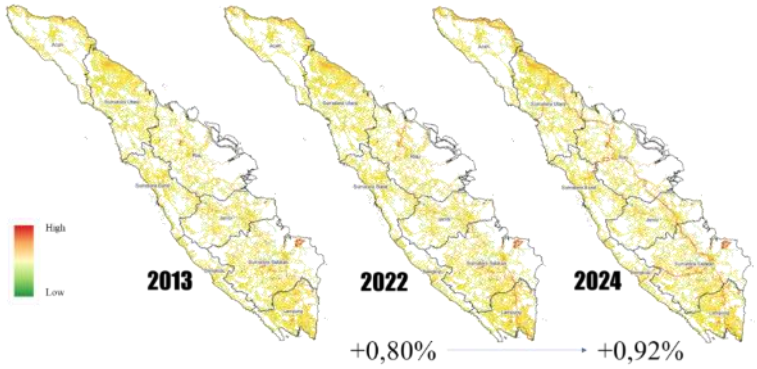

Figure 6. The connectivity of the road network in Sumatra Island

Table 6. The connectivity of the road network in Sumatra Island

Province	Connectivity in Years		
	2013	2022	2024
North Sumatra	4,072	4,115	4,154
Jambi	4,007	4,007	4,035
Bengkulu	4,025	4,041	4,083
West Sumatra	4,104	4,104	4,135
Aceh	4,001	4,024	4,078
South Sumatra	4,082	4,111	4,150
Riau	4,137	4,181	4,249
Lampung	4,019	4,121	4,121
Sumatra Island	4,056	4,088	4,126

Source: Researcher (2023)

The connectivity values of the road network in Sumatra Island (Table 6) show an average of 4.056 in 2013, 4.088 in 2022, and 4.126 in 2024. Connectivity growth is observed at 0.8% in 2022 and 0.92% in 2024. This increase indicates that the development of the Trans-Sumatra Toll Road has successfully enhanced connectivity between regions. The Province of Riau is projected to reach the highest connectivity value, i.e. 4.249, in 2024.

The closeness values of accessibility in Sumatra Island are presented in Figure 7. Unlike other syntax algorithms, the closeness value indicates the opposite; the lower the closeness value, the better the accessibility of the region. The significant construction of the PSN toll roads has effectively increased the accessibility value of Sumatra Island by 10.44% in 2022 and 146.27% in 2024 when all sections are completed.

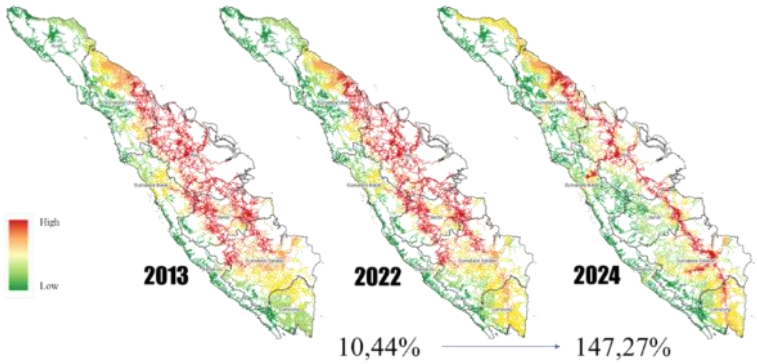

Figure 7. The closeness of the road network in Sumatra Island

Table 7. The closeness of the road network in Sumatra Island

Province	Closeness in Years		
	2013	2022	2024
North Sumatra	71.398,26	5.001,83	23.568,59
Jambi	65.173,26	60.600,46	30.317,98
Bengkulu	40.592,06	98.462,02	45.251,80
West Sumatra	73.851,14	68.503,04	27.997,87
Aceh	101.226,72	93.226,74	36.347,07
South Sumatra	68.891,93	63.303,00	22.348,56
Riau	58.871,83	52.638,43	19.181,38
Lampung	82.330,36	65.366,29	24.334,85
Sumatra Island	78.291,944	70.887,727	28.668,512

Source: Researcher (2023)

Table 7 shows the closeness values of the provincial road networks in Sumatra Island. Significant changes in closeness values are notable between 2013 and 2024. The average closeness value in Sumatra Island was 78.291 in 2013, significantly decreasing to 28.668 in 2024, indicating an increase in accessibility. The province with the largest increase in accessibility value is Aceh, while Lampung has the highest percentage increase in accessibility value.

The gravity values of the road network in Sumatra Island (Figure 8) indicate the concentration and the network's ability to attract movement, with the highest values observed in the provinces of Lampung, South Sumatra, and North Sumatra. Based on location, there is no changes in the structure of gravity attraction in 2013, 2022, and 2024; however, changes in gravity are evident due to an increase in gravity values. There is a 29.01% increase from 2013 to 2022, and a significant increase occurs upon the completion of the PSN, with a value of 92.03% from 2022 to 2024.

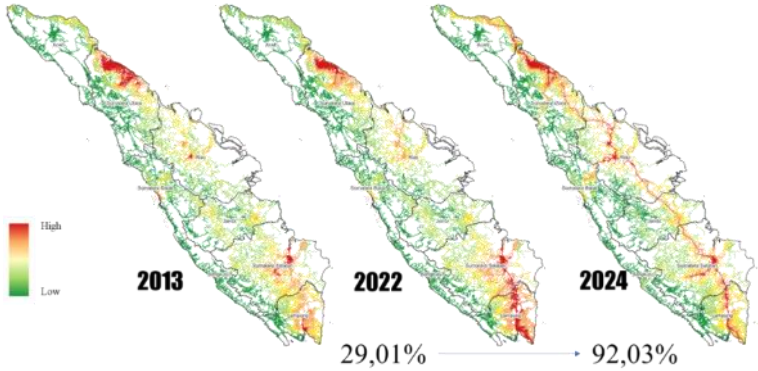

Figure 8. The gravity of the road network in Sumatra Island

Table 8. The gravitation of the road network in Sumatra Island

Province	Gravitation in Years		
	2013	2022	2024
North Sumatra	3,411	4,390	7,52
Jambi	1,844	2,026	4,31
Bengkulu	1,097	1,190	2,55
West Sumatra	1,981	2,076	4,36
Aceh	1,625	1,773	4,41
South Sumatra	2,471	3,528	6,13
Riau	2,225	2,753	6,86
Lampung	2,374	4,230	6,05
Sumatra Island	2,128	2,746	5,273

Source: Researcher (2023)

Table 8 shows a significant increase in the gravity attraction values occurring in each province. The average gravity value in Sumatra Island was 2.128 in 2013, increasing to 2.746 in 2022. The gravity value is predicted to increase to 5.273 in 2024 when the PSN road network is completed. The high correlation between the SDNA gravity algorithm and the NTL proxy PDRB suggests that when the gravity value increases significantly, a significant economic improvement is also predicted to occur in 2024.

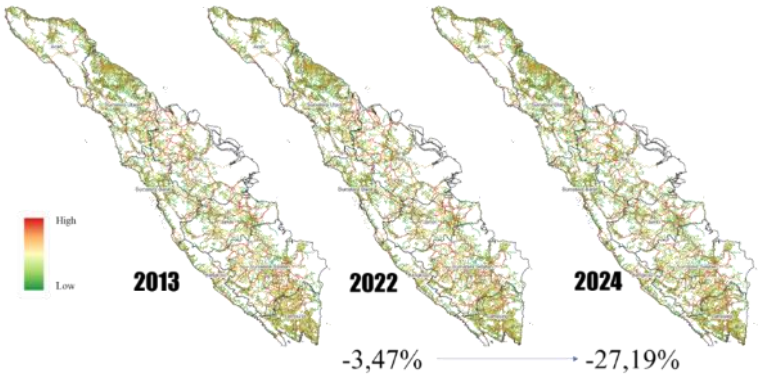

Figure 9. The betweenness of the road network in Sumatra Island

The betweenness value identifies the pathways that are most frequently chosen when moving from one point to another within a network. A high betweenness value signifies that the network traffic flow is concentrated along specific road segments, whereas a low betweenness value indicates more evenly distributed network traffic for traveling. In Sumatra Island, betweenness values exhibit a modest decline of 3.47% in 2022 and a substantial decrease of 27.19% by 2024. This decrease indicates a more equitable distribution of traffic across the road network and highlights the emergence of alternative routes following the completion of toll roads. The reduced betweenness values suggest enhanced connectivity and accessibility options for travelers in Sumatra Island.

Table 9. The betweenness of the road network in Sumatra Island

Province	Betweenness in Years		
	2013	2022	2024
North Sumatra	862,122	727,242	533,503
Jambi	795,000	814,302	394,560
Bengkulu	121,674	121,872	141,021
West Sumatra	377,242	377,191	347,301
Aceh	533,624	548,622	309,655
South Sumatra	582,894	526,042	407,232
Riau	940,412	958,769	777,871
Lampung	218,670	203,954	203,648
Sumatra	553,955	534,749	389,349

Source: Researcher (2023)

Table 9 shows that the average betweenness value in Sumatra Island in 2013 was 553.955, which changed to 389.349 in 2024. The most significant change occurred in the Province of Jambi, with a difference of 400.440 between 2024 and 2013.

Economic Agglomeration Analysis

The Trans-Sumatra Toll Road project offers an intriguing case study of the external impacts of infrastructure development on economic agglomeration. Utilizing fractal dimension analysis, this research measures agglomeration tendencies among economic centers, revealing that greater distances between road intersections imply stronger economic clustering. The findings suggest a gradual growth of economic agglomeration as the Trans-Sumatra project progresses.

The pre-construction measurements in 2013 indicated a maximum agglomeration scale of 1,417.68 meters. This scale expanded to 2,240.97 meters by 2022 during the project's active phase and is anticipated to leap to 3,546.65 meters by 2024 following completion. The fractal dimension is instrumental in quantifying the irregularity and pattern repetition within the road network, although it does not visually depict spatial consolidation. To address this issue, the study employs DBSCAN, which elucidates the diffusion and density of economic activities at these intersections.

In 2013, economic activities were concentrated around major cities such as Medan, Padang, Palembang, and Bandar Lampung. By 2022, significant changes were noted. Medan, Bandar Lampung, and Padang experienced expanded economic zones, whereas Palembang showed a reduced agglomeration, shifting from a primary to a medium-sized center while still continuing to grow locally.

Projections for 2024 indicate that Medan could consolidate its position as a dominant economic hub, influencing over a vast region. This indicates how enhanced connectivity via the Trans-Sumatra Toll Road could catalyze the emergence of new economic centers. Meanwhile, cities like Padang, Bandar Lampung, and Palembang are expected to maintain their economic significance but realign as medium-tier centers, with broadened spheres of economic activity reaching adjacent areas. This highlights the toll road's role in redistributing economic concentration across Sumatra.

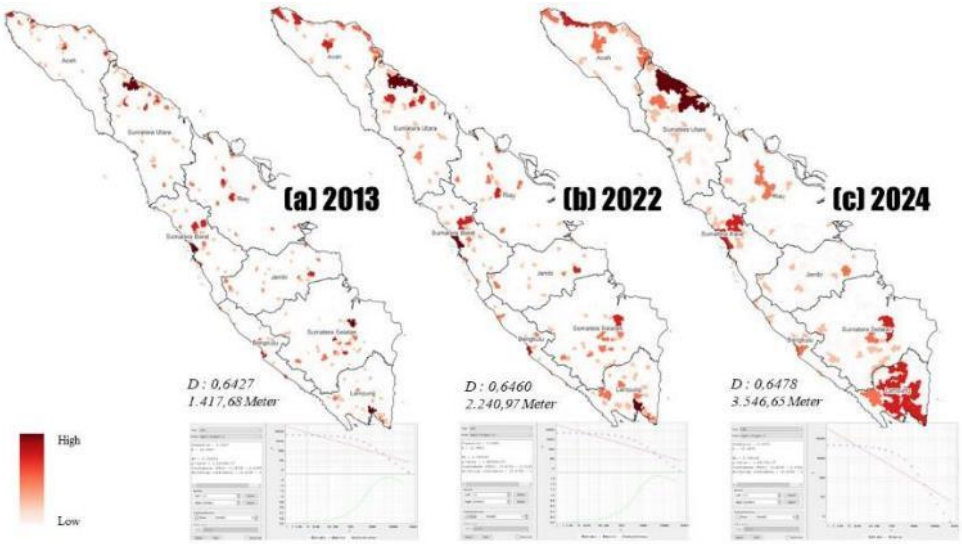

Figure 10. Economic agglomeration process in Sumatra (a) 2013; (b) 2022; (c) 2024 (100% completion of the Trans-Sumatra toll road)

The Trans-Sumatra Toll Road exemplifies the transformative power of road infrastructure on economic agglomeration. As a vital conduit for movement, it reshapes the geographical canvas of Sumatra Island, enhancing economic integration and fostering development. The emergence and enlargement of economic centers highlight the role of the roads in triggering regional economic dynamics, while also posing the challenge of managing these transitions to ensure equitable and sustainable growth across the island.

The study probes deeper than mere predictions for 2024; it endeavors to anticipate the zenith of economic agglomeration patterns that the Trans-Sumatra Toll Road might engender. As presented in Figure 11, the study predicts a future where the economic landscape reaches a state of heightened concentration at two further points: 5,556.74 meters and 8,706.08 meters, as foreseen by fractal dimension extrapolations post-2024. These projected distances suggest increasingly expansive economic clusters, extending well beyond the immediate surroundings of the toll road itself.

Using fractal dimension predictions to inform the DBSCAN analysis, the research forecasts a model for understanding how Sumatra's economic terrain could evolve with the road's completion. This prospective analysis is not just academic; it holds practical implications for policy-makers and stakeholders, preparing them for the possible ripple effects of infrastructural investments and enabling informed decisions that can steer economic activity toward the most beneficial outcomes for Sumatra Island's people and its economy.

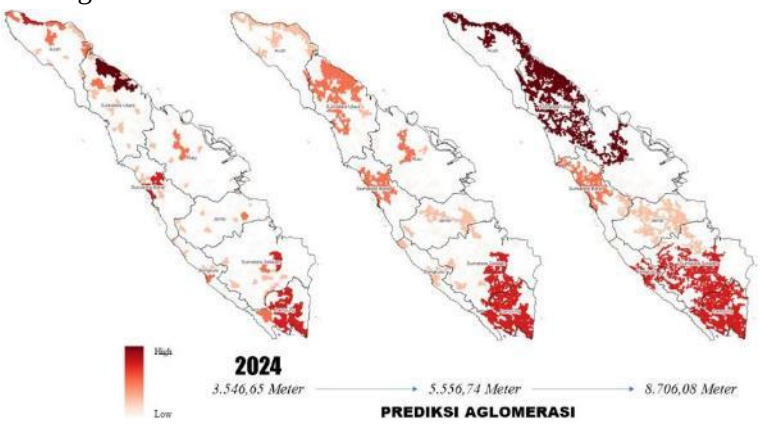

Figure 11. Long-term economic agglomeration prediction in Sumatra

The development of the Trans-Sumatra Toll Road signifies a transformative shift in Sumatra's economic geography, as it drives major shifts in economic agglomeration across the island. With the economic agglomeration scale expanding to 5,556.74 meters, there is a notable migration of the economic center from PKSN Kota Medan to PKN Bandar Lampung. Despite its categorization as a medium concentration area, the economic influence of Bandar Lampung significantly extends to Palembang and surrounding areas, thereby marking an unprecedented inter-provincial economic agglomeration.

As the economic agglomeration scale reaches its peak at 8,706.08 meters, the economic focus shifts back towards PKSN Kota Medan, which enhances economic intensity and extends its influence across Riau and Aceh. This development outlines the emergence of four principal economic

agglomeration zones in Sumatra: North Sumatra, Aceh, and Riau as the primary zone; Lampung, South Sumatra, and Bengkulu as the second; West Sumatra as the third; and Jambi, marginally extending into adjacent regions, as the fourth. These shifts show the crucial role of the Trans-Sumatra Toll Road in reshaping regional economic patterns and suggest a future where improved infrastructure could redefine Sumatra's economic landscape and enhance regional connectivity and development.

Analysis of Economic Activity Intensity

NTL data is used in this study as an innovative proxy to infer the GRDP of Sumatra and offer insights into the region's economic activity. This approach enables an analysis of the relationship between the characteristics of the road network and economic vitality, particularly in the context of the construction of the Trans-Sumatra Road. The concept of "economic agglomeration" is central to this analysis, referring to the concentration of economic activities within a certain area that not only serves as an economic hub but also boosts surrounding economic growth.

Before the construction of the Trans-Sumatra Road in 2013, the economic activity in Sumatra was mainly concentrated in key urban areas, as indicated by an NTL-based economic intensity value of 628,014. However, during the construction by 2022, there was a substantial increase in economic activity to 2,404,380, which accounts for a growth of 282.85%. This remarkable rise is attributed to the activation of areas that previously exhibited low economic activity, alongside the expansion of existing economic centers. Notably, new economic hubs also emerged and contributed to the overall uplift.

Looking ahead to the expected completion of the Trans-Sumatra Road in 2024, the intensity of economic activity in Sumatra is projected to reach 3,283,260, which would represent a 36.55% increase from 2022 levels. The most significant expansion is anticipated along the eastern corridor, from Aceh to North Sumatra, and across the Lampung region, with the least growth projected for Bengkulu. These findings reveal the transformative influence of the Trans-Sumatra Road and its potential to stimulate widespread economic development and reconfigure the economic landscape of Sumatra.

Figure 12. Dynamics of economic activity intensity in Sumatra (a) 2013; (b) 2022); (c) 2024 (100% completion of the Trans-Sumatra toll road)

This study goes further by attempting to forecast and predict the intensity of economic activity in Sumatra until the periods of 2035 and 2045. This prediction provides a deeper insight into how the economic activity patterns in Sumatra may evolve over time using linear programming. Over that time span, it appears that despite the emergence of new economic centers, the characteristic of strong agglomeration seems to be diminishing. The emerging pattern indicates a significant spread in economic intensity across various regions, thus creating a more diversified pattern.

The spatial depiction of this prediction indicates that despite some changes, the core of the economic activity pattern, which tends to be centralized, remains intact. The eastern corridor from Aceh to North Sumatra continues to be the focal point of economic activity, demonstrating continuity in its development. Additionally, a similar pattern persists in the overall Lampung region. However, it is important to note that this prediction also reflects a diversity in the distribution of the economy in Sumatra, indicating broader dynamics and shifts in the island's economic structure in the long term.

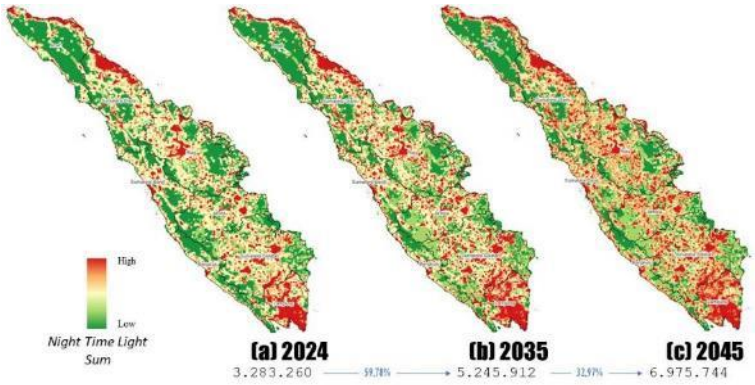

Figure 13. Predictions of Economic Activity Intensity in Sumatra (a) 2024; (b) 2035; (c) 2045

CONCLUSION

The research has successfully quantified the indirect impacts of the Trans-Sumatra Toll Road construction, focusing on spatial economic dynamics across cities and regions in Sumatra Islands. It has discussed changes in accessibility and connectivity, and forecasted the dynamics of economic agglomeration and activity intensity. Notably, the study highlights several positive and negative externalities of the toll road construction, including a predicted 3.5% increase in road intersections by 2024, and a strong correlation between NTL imagery and the GRDP. It suggests the potential of NTL as a reliable indicator of economic activity.

Additionally, the analysis noted an increase in connectivity and network centers, with a 1.72% rise in the degree of centrality, indicating growth in the road network and emergence of new network centers that boosts connectivity particularly in South Sumatra-Bengkulu and other regions. The research also highlighted a significant increase in gravitational attraction along the toll road, which suggests enhanced economic appeal.

The study observed a decrease in existing network load by about 15.33% by 2024, reflecting less congestion due to the new toll road. Closeness (accessibility) is projected to increase by approximately 78% in 2024, enhancing accessibility across the island, though Aceh and the western coastal areas

show lower improvements due to centralization in the eastern region. Significant changes in economic agglomeration patterns are evident, with Medan and its vicinity remaining central to economic activity through 2024. Beyond this, Sumatra is predicted to evolve into four major agglomeration regions. Changes in economic activity centers indicate that while there is a surge in economic activity peaking by 2024, a slowdown is expected by 2035-2045, suggesting a stabilization in economic activity levels but concentrated mainly along the eastern corridor.

In response to these findings, we propose several policies to enhance Sumatra's regional economy, including continued investment in road infrastructure to connect economically potent areas, development of regional economic centers, and enhancement of multimodal transport connectivity to bolster goods and people mobility. Regions with increased gravitational attraction need to diversify their economic potentials and develop infrastructure for transit hubs. Furthermore, we recommend improving accessibility by strategically planning new network interchanges and investing in supporting infrastructure. In regions projected to experience a decline in economic concentration, it is advisable to implement economic stimuli to sustain their economic contributions. Finally, anticipating future economic agglomeration patterns necessitates inter-provincial cooperation and integrated regional spatial planning to enhance connectivity and mitigate disparities across Sumatra.

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