

# Smart Mobility Development in Lampung Province? Analysis based on Medium Term Development Plan 2019-2024

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**Abstract.** This study aims to determine the development of smart mobility in Lampung province with an analysis based on the Medium-Term Development Plan 2019-2024. The method used is qualitative with analysis using Computer Assigned Data Qualitative Software Nvivo 12plus. Data visualization using theme identification analysis and crosstab analysis. The results showed that the Lampung provincial government is concerned in building smart mobility based on the Medium-Term Development Plan 2019-2024 with the classification of Information Communication and Technology (ICT) Infrastructure, Innovative and Safe Transportation System, Local Accessibility, and Sustainable. Of the four indicators, local accessibility is the main program of Lampung Province in building local networks and inter-regional transportation because access to social mobility is still difficult as many as 252 KM of roads are still in damaged condition. Then ICT infrastructure which is due to the still very minimal network and telecommunications by positioning ICT Lampung to 30 of the total provinces in Indonesia. Furthermore, Innovative and safe sustainable transportation is less detailed in the Medium-Term Development Plan document because the main focus is physical infrastructure.

## 1. Introduction

Smart mobility is part of the development of urban planning governance [1]. The United Nations is an institution that initiates 17 concepts of sustainable development and one of them is smart mobility [2] [3][4]. This sustainable development governance is also projected to improve urban environmental sustainability and efficiency and effectiveness [5]. Apart from that, smart mobility is also aimed at managing Information and Communication Technology (ICT) in every planning and design [6].

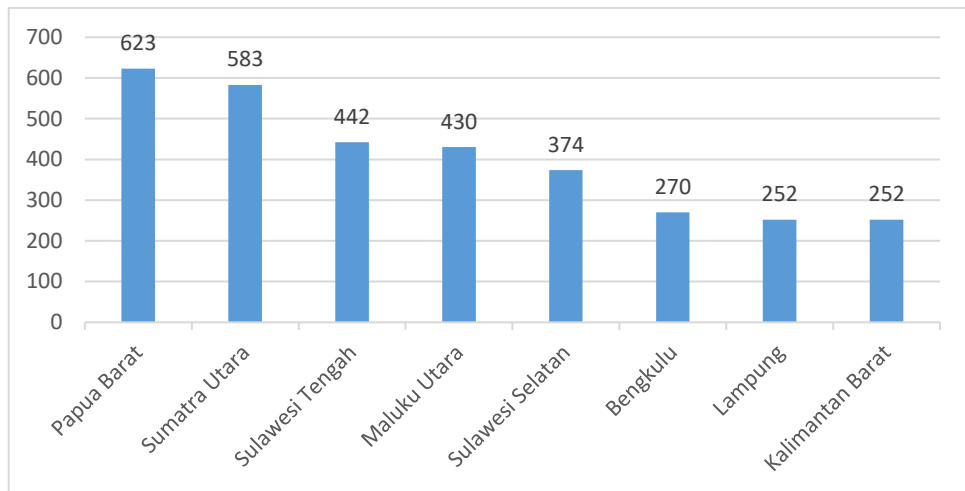
ICT used in smart mobility is characterized by the use of data, knowledge and information technology centers so that it will have an impact on ICT integration and sustainable transportation [8] [9]. Wawer (2022) explained several elements in the concept of smart mobility, namely ICT infrastructure, locally and internationally accessible, innovative, and a sustainable transportation system. This technology system will support the design of

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digital transportation visualization in real time, vehicle data mobilization, and digital prototypes on transportation trips [10][11].

In Indonesia, the concept of smart mobility is then adopted in the national and regional government development plans and then regulated through one of them the Regency Medium-Term Development Plan (RPJMD) in a five year period [12] [13]. The document contains various programs and developments carried out by the government in the next five years (Alma'Arif Wargadinata, 2022). Lampung Province is an area in the red zone category in the Regional Apparatus Organization (OPD) with a percentage of 80 percent [15] and problems from Human resources and infrastructure development that need to be further developed [16]. This is also supported by the following data figure 1:



**Fig 1.** Infrastructure Province in Indonesia

Source: [17]

The data above explains that Lampung Province is listed as one of the provinces with the longest damaged infrastructure in Indonesia. BPS defines it as a "heavily damaged road" because transportation mobility can only be carried out at a speed of between 0-20 KM per hour [18]. Nearly 25 percent of the infrastructure is in damaged condition along 165 KM and heavily damaged along 252 KM [19]. Then Lampung itself has the heaviest local accessibility between districts/cities in Sumatra (5,402 billions) [17] and supported by the intensity of the area with an area of 34,623.80 KM<sup>2</sup> or half of the worst province of North Sumatra with an area of 72,981.23 KM<sup>2</sup> (total damage of 5,798 billion).

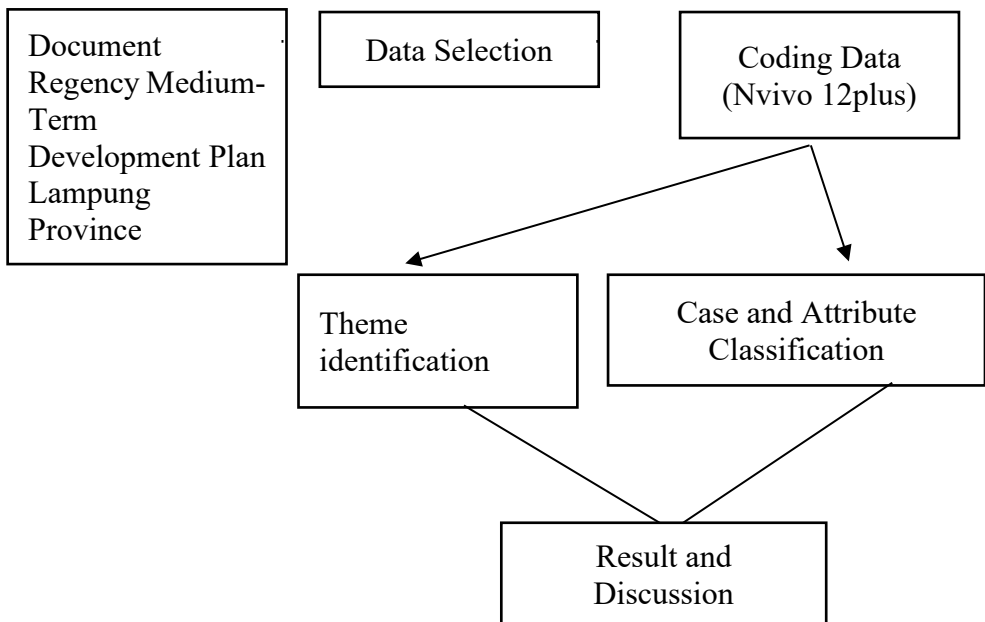
Therefore, based on the literature above, there is still no research linking the concept of smart mobility with the RPJMD. So the author wants analyzing the relationship between smart mobility and the Lampung Province RPJMD document, has it been planned? The study of smart mobility is crucial because it involves the mobilization of citizens through integrated transportation with Autonomous Vehicles (AV), "Flexible Transportation Services" (FTS), and "Free-floating e-mobility" (FFM) [20]. Then, other influencing factors are the encouragement of environmentally friendly fuels and public engagement, active mobility and inclusive mobility [21]. In addition, the urgency of smart mobility is solving problems with transportation infrastructure, urban digitization, and active governance strategies (accessible, equity, and sustainability) [22] [23] [24].

This research will use a thematic analysis approach to map the study of smart mobility with the Lampung Province RPJMD document. Therefore the formulation in this

study are: 1) How is the planning of smart mobility in Lampung Province? 2) Has Lampung Province implemented smart mobility and what is the potential for future development?

## 2. Research Method

This study uses qualitative methods with thematic analysis on the development of smart mobility in Lampung Province. Primary data was obtained from the 2019-2024 Lampung Province RPJMD documents. Then secondary data obtained articles, mass media, and documents that have relevance to the research topic. Data analysis uses Nvivo 12plus software with the following analysis process



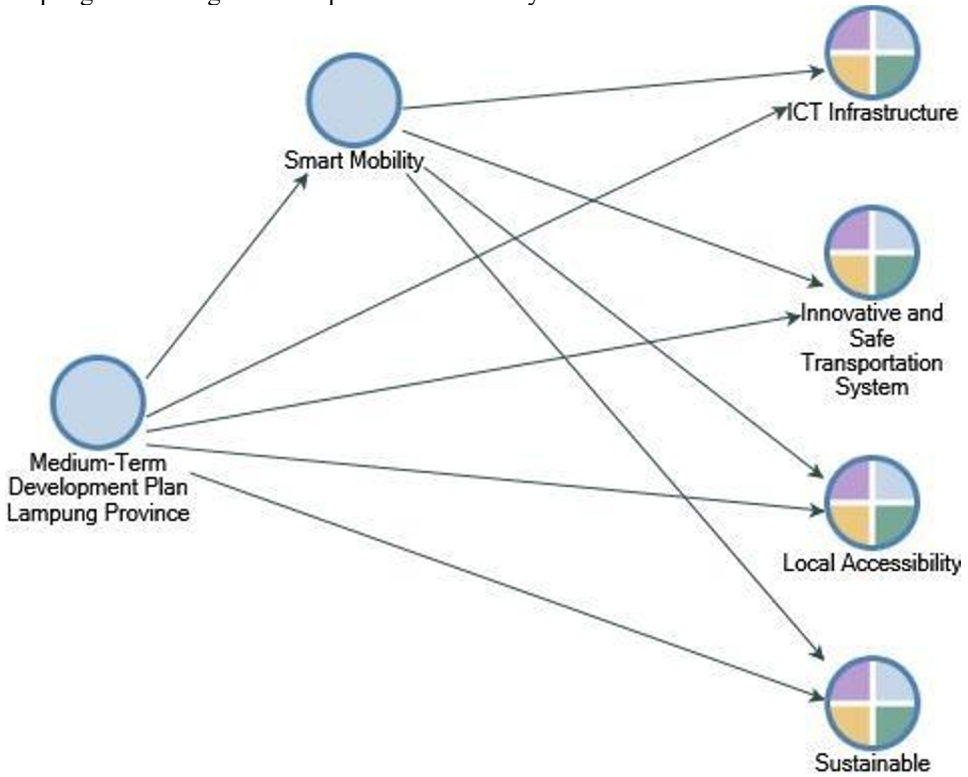
**Fig 2.** Data Analysis Process  
Source: by Authors (2023)

Data collection was carried out using Ncapture through the 2019-2024 RPJMD documents. Then coding the data to identify the themes and classification attributes of the RPJMD documents. The indicators used are local accessibility, ICT Infrastructure, sustainable, innovative and safe transportation system [25]. The theme mapping process is used to map the coding results which are then followed by the classification attributes.

## 3. Result and Discussion

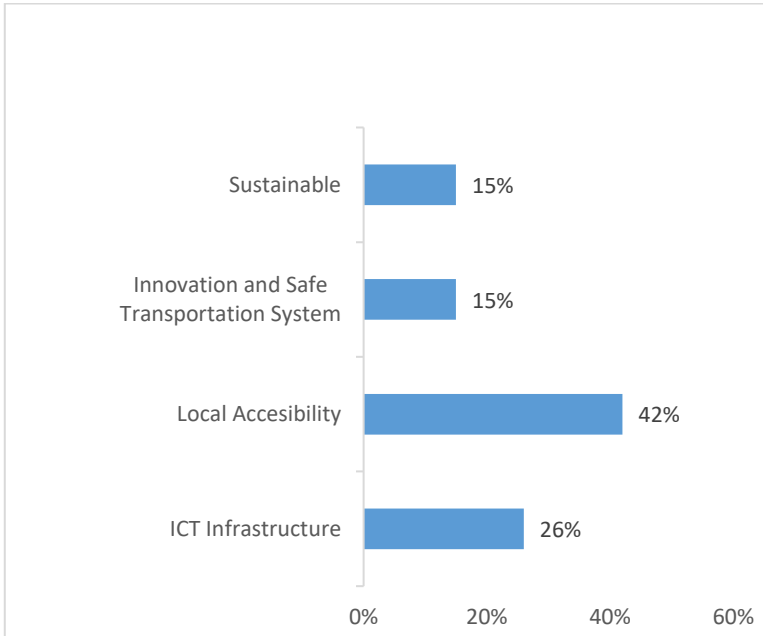
The 2019-2024 Lampung Province Regional Medium-Term Development Plan (RPJMD) document contains provincial government programs and policies for the next five

years. In this document the Provincial Government of Lampung also includes the concept of smart mobility in its planning. The following is the plan from the Provincial Government of Lampung in realizing the concept of smart mobility:



**Fig 3.** The Government Lampung Province Plan for Smart Mobility  
Source: Analysis Using Nvivo 12 Plus (2023)

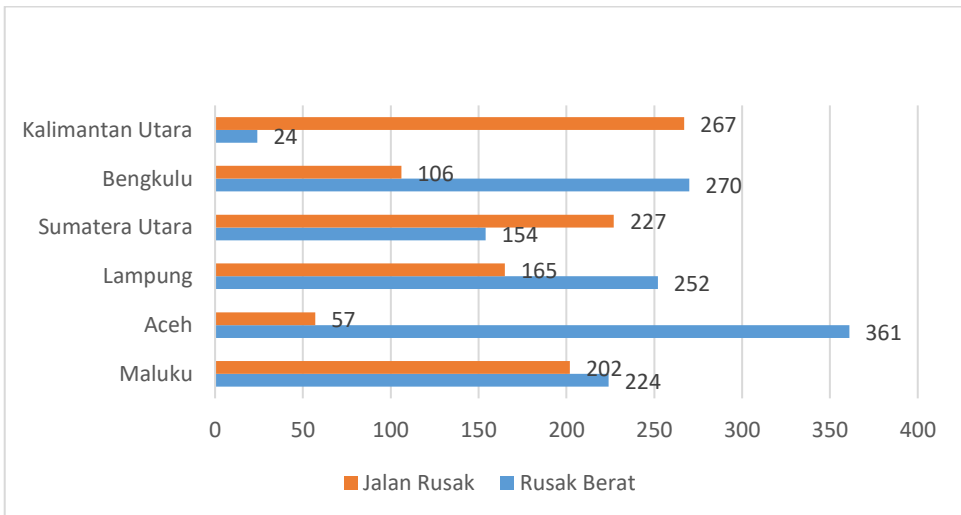
Figure 2 shows that it is wrong for the Lampung Provincial Government to design smart mobility for the 2019-2024 development period. The development of smart mobility is then presented by the authors in the results of the crosstab analysis as follows:



**Fig 4.** Crosstab Analysis Medium-Term Development Plan Lampung Province

Source: Analysis Using Nvivo 12 Plus (2023)

From the results of the coding above, it can be seen that the Provincial Government of Lampung in planning the concept of smart mobility has the highest local accessibility. In the RPJMD document it is stated that the program from local accessibility is planned to build road infrastructure to connect roads between provinces and between cities or surrounding districts. Sustainable (2022) describes Lampung as an area that has problems with access to transportation due to limited infrastructure that connects between local areas.

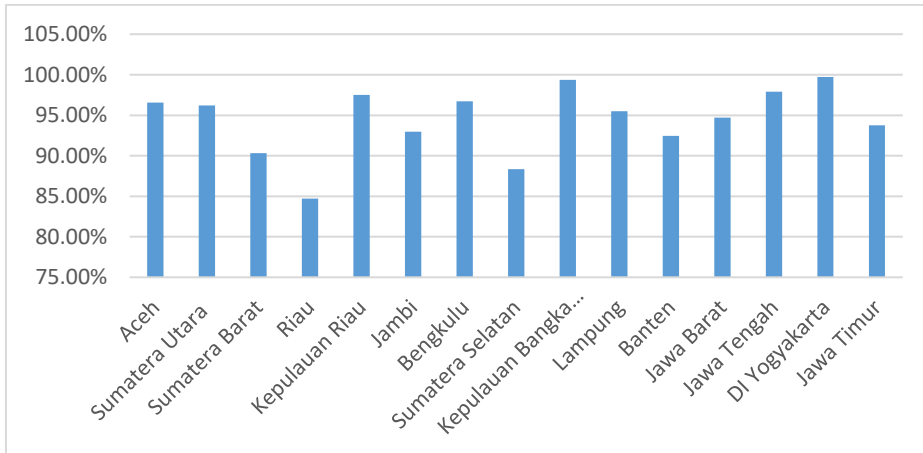


**Fig 5.** Infrastructure Conditions on Indonesia

Source:[27]

From the data graph above it is stated that the infrastructure in Lampung Province has the intensity of major problems in transportation access between local regions.

Roads with heavily damaged conditions reached 252 KM and 165 KM with damaged conditions. Therefore the main focus of the Government of Lampung is to carry out large-scale development of infrastructure in each unit [28]. In the Lampung government's RPJMD document, at least it is stated that there are three main priorities for infrastructure development in supporting regional accessibility, namely: 1) building and environmental infrastructure and facilities, 2) transportation infrastructure, 3) service infrastructure. The main goal is to ensure accessible mobility between regions (Primary & Imawan, 2019).



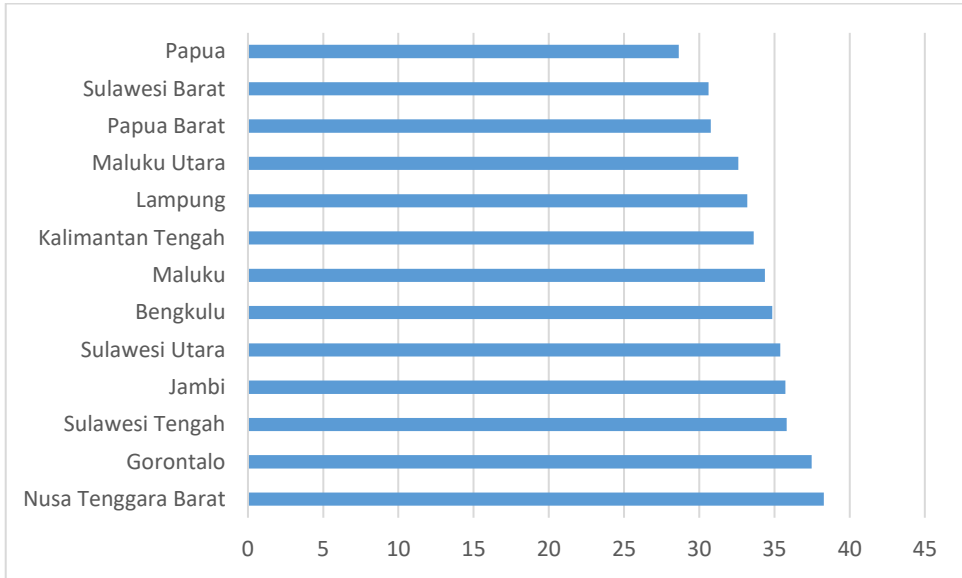
**Fig 6.** Accessibility infrastructure Indonesia

Source: (Ministry of PUPR, 2021)

In addition to being a top priority of the Provincial Government Lampung, the infrastructure development program is also the main program of the national government to encourage transportation between regions. From the program, data from the Ministry of Public Works and Public Housing above states that 95% of national infrastructure projects have been running in Lampung Province. This is also supported by the commitment of the national government to carry out national strategic projects in every region in Indonesia with the aim of an accessible mobility network [31] [32].

Then the next aspect that also supports the concept of smart mobility is ICT Infrastructure which is the parameter for thinking about the dimensions of a smart city [33][34] [35]. To support the flow of mobility, ICT devices are needed to optimize transportation with technological infrastructure [36] [37]. The resulting impact is on the aspect of spatial integration between infrastructure, human, business, consumption, energy and space technology networks [37][38].

The Provincial Government of Lampung in the RPJMD document states that the construction of telecommunication infrastructure and networks between area. In addition, establish a technology network to accelerate the process of reporting, communication and execution of infrastructure improvements. However, in social reality there is still a tendency towards difficulties in reaching transportation access to support mobility[39].



**Fig 7. Digital Infrastructure Indonesia**  
Source:[40]

The data presents the condition of digitizing infrastructure in each Indonesian province, and Lampung itself occupies the 33.19th position or the 30th position of all provinces. Of course, in this case it is a bit ironic because the available ICT infrastructure is still very minimal with a percentage of 22.19 percent. ICT infrastructure in the concept of smart mobility development is the main infrastructure that is significantly positive for smart transportation management [41]. ICT has an important projection on integrated information systems from Information Technology with virtual information systems and information system architectures[42] [43]. Apart from that, the basis for the existence of ICT infrastructure is the foundation (mobile technology, websites, and digital government) for the realization of smart mobility [44].

The concept of ICT Infrastructure (Smart Mobility) according to the Ministry of PUPR at least has factors such as EV Charging and Infrastructure, Traffic Mgt, Tolling Management, Railway MGT, Tunnel Management, and Airport Solutions (Ministry of PUPR, 2022). The Lampung Province Medium-term Development Plan 2019-2024 document does not find the program as a step towards smart mobility. The data is also clarified in the increase in traffic violations in 2022 which increased to 31.28 percent or 8,729 cases [46]. According to the Lampung Police Chief, this happened due to inadequate transportation facilities and infrastructure in the development of the digitalization trend and the increasing number of transportation. This then becomes a complaint for traffic users that all roads in Lampung Province do not yet have street lighting [47].

Then in the indicators of innovation and safe transportation, the Provincial Government of Lampung through the RPJMD document only has an effort program for routine maintenance of roads and bridges. Apart from that, another thing is the fast response unit for repairing existing infrastructure. Innovative and safe transportation here is meant as a technological innovation that is offered through the best possible connectivity between people, vehicles and digital infrastructure [48] [49] [50]. Gang Kou & Serhat Yuksel (2022) explained in the research that this innovative and safe transportation concept can be realized with a program strategy of reducing carbon emission gas by projecting it on environmentally

friendly vehicles.

Therefore, a conclusion can be drawn that the Provincial Government of Lampung does not yet have a plan or program that leads to innovation and safe transportation. This happens because of the main priority, namely physical development to establish transportation accessibility [52].

Then in the last indicator namely sustainable which can then be interpreted as a design or model of transportation that is modern, electric, environmentally friendly, digitized in the system [53] [54]. The smart mobility model that prioritizes sustainability will be framed within the smart city framework in growing smart cities. In the context of Lampung Province itself, links between programs or plans that lead to sustainability have not been found from the analysis of the RPJMD development documents. It can be seen that the sustainable priority that will be pursued by the local government is strengthening the sources of apparatus and infrastructure that are fast, responsive and appropriate. In addition to re-functioning regional infrastructure networks (Sumatra toll roads, national roads, seaports, ferry ports, wharves, railways and airports) to improve external connectivity.

#### 4. Conclusion

In general, the Lampung provincial government has not implicitly implemented smart mobility, which is regulated through the 2019-2024 RPJMD. This is because Lampung's main problem is in the road accessibility sector. Many found that road accessibility is still classified as very unfit (damaged) so that the future projections of smart mobility are still very far away and left behind.

Then, ICT devices regulated in the realization of smart mobility in Lampung province are also still minimal because they themselves are in 30th position out of provinces in Indonesia. So that's what causes smart mobility in Lampung not to work with such a projection. That's why the Lampung government is still focusing on physical infrastructure to build accessibility to support community mobilization.

#### References

- [1] C. Bıyık *et al.*, "Smart mobility adoption: A review of the literature," *J. Open Innov. Technol. Mark. Complex.*, vol. 7, no. 2, p. 146, 2021, doi: 10.3390/joitmc7020146.
- [2] K. Hassanzadehkermanshahi and S. Shirowzhan, "Measuring Urban Sustainability over Time at National and Regional Scale for Addressing United Nations Sustainable Development Goal (SDG) 11: Iran and Tehran as Case Studies," *Sustain.*, vol. 14, no. 12, pp. 1–25, 2022, doi: 10.3390/su14127402.
- [3] K. L. Whittingham, A. G. Earle, D. I. Leyva-de la Hiz, and A. Argiolas, "The impact of the United Nations Sustainable Development Goals on corporate sustainability reporting," *BRQ Bus. Res. Q.*, vol. 26, no. 1, pp. 45–61, 2023, doi: 10.1177/23409444221085585.
- [4] L. Carlsen and R. Bruggemann, "The 17 United Nations' sustainable development goals: a status by 2020," *Int. J. Sustain. Dev. World Ecol.*, vol. 29, no. 3, pp. 219–229, 2022, doi: 10.1080/13504509.2021.1948456.
- [5] S. Šurdonja, T. Giuffrè, and A. Deluka-Tibljaš, "Smart mobility solutions-necessary precondition for a well-functioning smart city," *Transp. Res. Procedia*, vol. 45, no. 2019, pp. 604–611, 2020, doi: 10.1016/j.trpro.2020.03.051.
- [6] K. S. Willis and C. Nold, "Sense and the city: An Emotion Data Framework for smart



- city governance,” *J. Urban Manag.*, vol. 11, no. 2, pp. 142–152, 2022, doi: 10.1016/j.jum.2022.05.009.
- [7] S. Porru, F. E. Misso, F. E. Pani, and C. Repetto, “Smart mobility and public transport: Opportunities and challenges in rural and urban areas,” *J. Traffic Transp. Eng. (English Ed.)*, vol. 7, no. 1, pp. 88–97, 2020, doi: 10.1016/j.jtte.2019.10.002.
- [8] D. L. Angarita Lozano, S. E. Diaz Marquez, and M. E. Morales Puentes, “Sustainable and smart mobility evaluation since citizen participation in responsive cities,” *Transp. Res. Procedia*, vol. 58, pp. 519–526, 2021, doi: 10.1016/j.trpro.2021.11.069.
- [9] M. Wawer, K. Grzesiuk, and D. Jegorow, “Smart Mobility in a Smart City in the Context of Generation Z Sustainability, Use of ICT, and Participation,” *Energies*, vol. 15, no. 13, pp. 1–30, 2022, doi: 10.3390/en15134651.
- [10] R. Juvenile Ehwi, H. Holmes, S. Maslova, and G. Burgess, “The ethical underpinnings of Smart City governance: Decision-making in the Smart Cambridge programme, UK,” *Urban Stud.*, 2022, doi: 10.1177/00420980211064983.
- [11] A. Kirimtat, O. Krejcar, A. Kertesz, and M. F. Tasgetiren, “Future Trends and Current State of Smart City Concepts: A Survey,” *IEEE*, vol. 8, pp. 86448–86467, 2020, doi: 10.1109/ACCESS.2020.2992441.
- [12] I. R. Rustan, J. Nawawi, N. Nara, and ..., “Regional Medium-Term Development Planning Based On Regional Development From Top-Down Approach,” *J. Posit. ....*, vol. 6, no. 6, pp. 3327–3338, 2022, [Online]. Available: <https://www.journalppw.com/index.php/jpsp/article/view/7857%0Ahttps://www.journalppw.com/index.php/jpsp/article/download/7857/5125>.
- [13] S. Sumadi, O. Ardhiarisca, R. R. Wijayanti, and R. Putra, “Evaluation of Development Planning in Kemuning Lor Village, Arjasa District, Jember Regency,” *Proc. 2nd Int. Conf. Soc. Sci. Humanit. Public Heal. (icosh. 2021)*, vol. 645, no. Icoship 2021, pp. 33–39, 2022, doi: 10.2991/assehr.k.220207.006.
- [14] E. L. Alma’Arif Wargadinata, “Adopting Open Government in Local Development Planning,” *J. Kebijak. dan Adm. Publik*, vol. 26, no. 1, pp. 18–32, 2022, [Online]. Available: <https://journal.ugm.ac.id/jkap>.
- [15] S. S. Hutagalung and D. Hermawan, “Evaluation of Local Government Innovation Program in Lampung Province,” *J. Bina Praja*, vol. 10, no. 2, pp. 241–250, 2018, doi: 10.21787/jbp.10.2018.241-250.
- [16] K. Romli, M. Oktaviannur, D. Rinova, and Y. Y. Dharmawan, “Analysis of Tourism Mapping in Lampung Province to Optimize Entrepreneurship Development,” *Rev. Integr. Bus. Econ. Res.*, vol. 8, no. December, p. 110, 2019.
- [17] I. G. Osawaldo, “10 Provinsi dengan Jalan Rusak Terbanyak di RI, Nomor 1 Bukan Lampung,” *finance.detik.com*, 2023.
- [18] C. M. Annur, “Lampung Masuk Daftar 10 Provinsi dengan Jalan Rusak Berat Terpanjang,” *Katadata.com*, 2023.
- [19] A. Lidwina, “Cek Data: Ramai Dikritik di Medsos, Bagaimana Kondisi Ekonomi Lampung?,” *Katadata.com*, 2023.
- [20] L. Butler, T. Yigitcanlar, and A. Paz, “How can smart mobility innovations alleviate transportation disadvantage? Assembling a conceptual framework through a systematic review,” *Appl. Sci.*, vol. 10, no. 18, 2020, doi: 10.3390/AP10186306.
- [21] S. Paiva, M. A. Ahad, G. Tripathi, N. Feroz, and G. Casalino, “Enabling technologies for urban smart mobility: Recent trends, opportunities and challenges,” *Sensors*, vol. 21, no. 6, pp. 1–45, 2021, doi: 10.3390/s21062143.
- [22] B. C. Ibănescu, G. C. Pascariu, A. Bănică, and I. Bejenaru, “Smart city: A critical assessment of the concept and its implementation in Romanian urban strategies,” *J. Urban Manag.*, vol. 11, no. 2, pp. 246–255, 2022, doi: 10.1016/j.jum.2022.05.003.
- [23] A. Wallsten, M. Henriksson, and K. Isaksson, “The Role of Local Public Authorities

- in Steering toward Smart and Sustainable Mobility: Findings from the Stockholm Metropolitan Area,” *Plan. Pract. Res.*, vol. 37, no. 5, pp. 532–546, 2021, doi: 10.1080/02697459.2021.1874638.
- [24] H. Pan, S. Geertman, B. Deal, J. Jiao, and B. Wang, “Planning Support for Smart Cities in the Post-COVID Era,” *J. Urban Technol.*, vol. 29, no. 2, pp. 1–5, 2022, doi: 10.1080/10630732.2022.2069938.
- [25] F. A. Nuzir and R. Saifuddin, “Smart people, smart mobility,” *Konsep Kota Pint. yang Bertumpu pada Masy. dan pergerakannya di Kota Metro*, vol. 2008, no. September, pp. 1–5, 2015, doi: 10.13140/RG.2.1.3056.4324.
- [26] R. Lestari, T. Rachmawati, F. A. Kamandanu, and D. Syahrobi, “Lampung Tourism Supply During the Pandemic and Post Covid-19 Pandemic,” in *Proceedings of the 2nd International Indonesia Conference on Interdisciplinary Studies (IICIS 2021)*, 2022, vol. 606, no. Iicis, pp. 78–86, doi: 10.2991/assehr.k.211206.012.
- [27] BPS, “15 Provinsi dengan Jalan Provinsi & Rusak Berat Terpanjang di Indonesia,” 2023.
- [28] M. A. B. Nadi, Nurfaizia, M. N. Karunia, W. A. N. Aspar, W. Barasa, and A. Fudholi, “Characterization of Site Effect and Natural Frequency of Railway Bridges,” *Int. J. Sustain. Dev. Plan.*, vol. 17, no. 1, pp. 243–249, 2022, doi: 10.18280/ijstdp.170124.
- [29] A. B. Pratama and S. A. Imawan, “A scale for measuring perceived bureaucratic readiness for smart cities in Indonesia,” *Public Adm. Policy*, vol. 22, no. 1, pp. 25–39, 2019, doi: 10.1108/PAP-01-2019-0001.
- [30] KementerianPUPR, *Informasi Statistik Infrastruktur PUPR 2021*. Jakarta: Pusat Data dan Teknologi Informasi, 2021.
- [31] A. F. Hidayatullah, M. R. Ma’arif, M. Habibie, and S. Khomsah, “Indonesia Infrastructure Development Topic Discovery on Online News with Latent Dirichlet Allocation,” *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 1077, no. 1, p. 012012, 2021, doi: 10.1088/1757-899x/1077/1/012012.
- [32] Z. S. Kusharsanto, N. Maninggar, Suhandoyo, D. Maulidya, and A. R. Muzaki, “How infrastructure contributes to fostering Regional Innovation System: The case of Pelalawan Regency - Indonesia,” *IOP Conf. Ser. Earth Environ. Sci.*, vol. 778, no. 1, 2021, doi: 10.1088/1755-1315/778/1/012001.
- [33] T. Träskman, “Smartness and thinking infrastructure: an exploration of a city becoming smart,” *J. Public Budgeting, Account. Financ. Manag.*, vol. 34, no. 5, pp. 665–688, 2022, doi: 10.1108/JPBAFM-12-2020-0200.
- [34] F. Brandajs and A. P. Russo, “Smarter city, less just destination? Mobilities and social gaps in Barcelona,” *J. Place Manag. Dev.*, vol. 16, no. 2, pp. 291–308, 2023, doi: 10.1108/jpmd-03-2022-0020.
- [35] L. Penco, E. Ivaldi, and A. Ciacci, “Entrepreneurial ecosystem and well-being in European smart cities: a comparative perspective,” *TQM J.*, vol. 33, no. 7, pp. 318–350, 2021, doi: 10.1108/TQM-04-2021-0097.
- [36] M. S. Samsurijan, A. Ebekozién, N. A. Nor Azazi, M. M. Shaed, and R. F. Radin Badaruddin, “Artificial intelligence in urban services in Malaysia: a review,” *PSU Res. Rev.*, 2023, doi: 10.1108/PRR-07-2021-0034.
- [37] L. H. C. Pinochet, G. F. Romani, C. A. de Souza, and G. Rodríguez-Abitia, “Intention to live in a smart city based on its characteristics in the perception by the young public,” *Rev. Gest.*, vol. 26, no. 1, pp. 73–92, 2019, doi: 10.1108/REGE-06-2018-0077.
- [38] W. Matli and S. F. Wamba, “Work from anywhere: inequalities in technology infrastructure distribution for digit workers,” *Digit. Transform. Soc.*, vol. 2, no. 2, pp. 149–162, 2023, doi: 10.1108/dts-08-2022-0042.
- [39] N. Nairobi and R. Respitasari, “Public Infrastructure and Economic Growth in the

- Local Region,” *J. Ekon. Pambang.*, vol. 19, no. 1, pp. 51–60, 2021, doi: 10.29259/jep.v19i1.13826.
- [40] Kominfo, “Indeks Masyarakat Digital,” Jakarta, 2022.
- [41] O. Adeola and O. Evans, “ICT, infrastructure, and tourism development in Africa,” *Tour. Econ.*, vol. 26, no. 1, pp. 97–114, 2020, doi: 10.1177/1354816619827712.
- [42] N. S. N. Wahab, T. W. Seow, I. S. M. Radzuan, and S. Mohamed, “A Systematic Literature Review on the Dimensions of Smart Cities,” in *5th International Conference on Civil and Environmental Engineering for Sustainability, IConCEES 2019*, 2020, vol. 498, no. 1, doi: 10.1088/1755-1315/498/1/012087.
- [43] C. C. Okafor, C. Aigbavboa, and W. D. Thwala, “A Delphi approach to evaluating the success factors for the application of smart mobility systems in smart cities: a construction industry perspective,” *Int. J. Constr. Manag.*, vol. 0, no. 0, pp. 1–10, 2021, doi: 10.1080/15623599.2021.1968567.
- [44] G. Puron-Cid and J. R. Gil-Garcia, “Are Smart Cities Too Expensive in the Long Term? Analyzing the Effects of ICT Infrastructure on Municipal Financial Sustainability,” *Sustain.*, vol. 14, no. 10, 2022, doi: 10.3390/su14106055.
- [45] KementerianPUPR, “Konsep Smart City,” 2022.
- [46] Tvonenews.com, “Kapolda Lampung: Pelanggaran Lalu Lintas Tahun 2022 Meningkat 31,28 Persen,” 2023. [Online]. Available: <https://www.tvonenews.com/daerah/sumatera/99082-kapolda-lampung-pelanggaran-lalu-lintas-tahun-2022-meningkat-3128-persen?page=1>.
- [47] V. Oktavia, “Pemudik Mulai Ramaikan Lampung, Jalan Rusak dan Minimnya Penerangan Dikeluhkan,” 2023. [Online]. Available: <https://www.kompas.id/baca/nusantara/2023/04/18/pemudik-mulai-ramaikan-lampung-jalan-rusak-dan-minimnya-penerangan-dikeluhkan>.
- [48] A. Pompigna and R. Mauro, “Smart roads: A state of the art of highways innovations in the Smart Age,” *Eng. Sci. Technol. an Int. J.*, vol. 25, p. 100986, 2022, doi: 10.1016/j.jestch.2021.04.005.
- [49] S. S. V. Subbarao and R. Kadali, “Impact of COVID-19 pandemic lockdown on the public transportation system and strategic plans to improve PT ridership: a review,” *Innov. Infrastruct. Solut.*, vol. 7, no. 1, pp. 1–14, 2022, doi: 10.1007/s41062-021-00693-9.
- [50] A. Marusin, A. Marusin, and T. Ablyazov, “Transport infrastructure safety improvement based on digital technology implementation,” *Atl. Press*, vol. 1, no. Icdtli, pp. 353–357, 2019, doi: 10.2991/icdtli-19.2019.61.
- [51] H. D. Gang Kou, Serhat Yuksel, “Inventive problem-solving map of innovative carbon emission strategies for solar energy-based transportation investment projects,” *Appl. Energy*, 2022, doi: <https://doi.org/10.1016/j.apenergy.2022.118680>.
- [52] C. B. Azolibe and J. J. Okonkwo, “Infrastructure development and industrial sector productivity in Sub-Saharan Africa,” *J. Econ. Dev.*, vol. 22, no. 1, pp. 91–109, 2020, doi: 10.1108/jed-11-2019-0062.
- [53] M. Pańkowska and A. Sołtysik-Piorunkiewicz, “ICT Supported Urban Sustainability by Example of Silesian Metropolis,” *Sustain.*, vol. 14, no. 3, 2022, doi: 10.3390/su14031586.
- [54] N. Mittal, R. Agarwal, and W. Selen, “Value creation and the impact of policy interventions: Indian LPG supply chain case study,” *Int. J. Logist. Manag.*, vol. 29, no. 1, pp. 64–89, 2018, doi: 10.1108/IJLM-10-2016-0242.