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The Impact of Infrastructure Management and Information Systems on Teacher's Learning Innovation in the Digital Transformation of Schools

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Abstract: Digital transformation in education requires effective infrastructure and information systems to foster teacher innovation. This study examines the influence of infrastructure management and information systems on teacher learning innovation in public junior high schools in Palembang, Indonesia. This research uses a descriptive method with a quantitative approach. A quantitative survey was administered to 88 teachers. The research instrument was a Likert scale questionnaire which had been tested for validity and reliability. Results from multiple regression analysis revealed that both infrastructure management ($p = 0.031$) and information systems ($p < 0.001$) significantly predicted teacher learning innovation, collectively explaining 42.8% of the variance. These findings underscore the importance of infrastructure and information system management, in this case integrated digital resources, in supporting pedagogical innovation during the digital transformation of education.

Keywords: Digital Transformation, Information Systems, Infrastructure Management, Teacher's Learning Innovation

A. Introduction

Education must change in the 21st century. With learning styles becoming more responsive, visual, and interactive, learning approaches that can meet individual needs and encourage problem solving and creativity are needed. In the era of Society 5.0, new skills are required. 21st-century skills such as digital literacy, cross-cultural collaboration, and critical thinking are essential for success in an increasingly complex and connected world (Amelia, 2023). This requires creativity and innovation from teachers to be able to provide the necessary new skills. Changes that occurred in the 21st century also occurred in the acceleration of the development of digital-based information technology. With the development of information and communication technology, schools must change their management systems and learning methods.

Technology integration is an important way to improve the quality of national education in order to achieve the Vision of Golden Indonesia 2045 (Putri et al., 2025). Information technology will help teachers and students in education (Wahyuni Firli Fangestu & Syahrizal, 2023). Therefore, to face digital transformation, educational institutions must use innovative approaches. Schools as educational institutions must also be able to manage and utilize resources, including facilities and infrastructure, to increase the efficiency of the teaching and learning process. These strategies include the implementation of academic information systems and the use of technology-based learning approaches such as e-learning, artificial intelligence (AI), and big data (Teknologi, 2025).

The innovation can generate value in various learning methods, which basically require school infrastructure and information systems, which include technology and digitalization. One of the important factors in creating a pleasant learning environment and encouraging learning innovation is good management of facilities and infrastructure. Infrastructure alone is not enough without good management. This management directly helps the learning process run well in a supportive environment (Andayani et al., 2025). Good management includes planning and procurement, utilization, maintenance, and an orderly and accountable inventory system to support innovation. Many schools have complete facilities and infrastructure, but poor management hinders educational progress (Ikhwan & Qomariyah, 2022). On the other hand, certain educational institutions are slow to develop, but others are rapidly implementing information technology and systems in various aspects of the organization, such as the learning process. Therefore, apart from infrastructure, education practitioners must also pay attention to management information systems in the world of modern education. Management information systems is a part of management science that includes planning, organizing, motivating, and controlling how human resources and other resources are used to achieve goals (Dewi et al., 2022). One type of information technology is an information system, which is a combination of components that are integrated with each other and arranged in such a way that they help an organization's business by identifying information (Jordan & Andry, 2024).

Along with the acceleration of digitalization, the system in the world of education is also changing. With the change in the system, it will encourage the acceleration of the delivery and retrieval of information. This is in line with what the Ministry of Education, Culture, Research, and Technology did in 2020, which carried out a digital transformation in the world of education through the belajar.id account, a system designed to improve the quality of education. Included in the belajar.id account is the Rumah Belajar facility which allows teachers to obtain learning resources, get inspiration, and share experiences and practices with other teachers throughout Indonesia (Kusumaningsih, 2024).

As the main actors in the learning process, teachers must continue to innovate in the use of educational technology. Teachers must have the ability to innovate in every learning process if they want education to progress. This innovation includes the ability of teachers to develop innovative methods that are appropriate to students' needs and to design, implement, and disseminate technology-based learning. Teachers must also be able to encourage students to think more creatively and critically. This is in line with the opinion that states that in addition to having a solid understanding of the material, teachers must be able to foster an engaging and pertinent learning environment that inspires pupils to think critically and creatively (Wahyuni et al., 2025). So, with the learning innovations carried out by teachers in the 21st century, it will improve the quality of learning and increase students' interest in learning.

Initial observations conducted at SMP Negeri Kecamatan Ilir Timur II Palembang showed that several teachers used technology in the learning process which was one of the teachers' learning innovations. In addition, there are also some teachers who use various learning strategies. In this case, it certainly requires adequate facilities and infrastructure and skills in using the information systems available at the school. Then, during the observation, it was also found that there were several teachers who still had difficulty and limited use of the existing facilities and infrastructure. In the use of information systems, some teachers still have difficulty using the information systems available at school, such as SIM PKB, the use of belajar.id accounts, and e-learning. Thus, limitations in the utilization of school infrastructure and information systems as well as the integration of information systems raise questions about the extent to which the management of school infrastructure and information systems can influence teacher learning innovation. Therefore, it is very important to conduct an in-depth analysis of the influence of Infrastructure Management and Information Systems on Teacher Learning Innovation in the current digital era transformation.

Based on the description above, the problem formulation in this article is as follows: 1) Is there any influence of infrastructure management on teacher learning innovation? 2) Is there any influence of information systems on teacher learning innovation? and 3) Is there any influence of infrastructure management and information systems on teacher learning innovation? In accordance with the formulation of the problem, the research objectives in this article are as follows: 1) To analyze the influence of infrastructure management on teacher learning innovation, 2) To analyze the influence of information systems on teacher learning innovation, and 3) To analyze the influence of infrastructure management and information systems on teacher learning innovation. It is hoped that this article can provide conceptual contributions to educational policy makers, school principals and teachers. This article is also expected to provide theoretical contributions that can help in the development of educational management

theory, particularly in relation to the management of educational facilities and infrastructure, the use of information systems, and innovation in teacher learning.

B. Methods

This research uses a quantitative descriptive method with a correlational approach. Quantitative research uses numerical data to answer research questions. Quantitative research is often used to study relationships between variables, measure frequencies, or find patterns in a particular population. This approach emphasizes objective measurement, consistent data collection, and the use of statistical analysis to test hypotheses or explain a phenomenon (Waruwu et al., 2025). The research population was all teachers who taught at Public Middle Schools in Ilir Timur II District, Palembang, totaling 88 people. The research sample used was all teachers included in the research population, namely 88 teachers. Data were collected through observation, research questionnaires, and documentation. The questionnaire was collected in a closed manner using a Likert scale of 1–5, ranging from strongly disagree to strongly agree. The following is a grid of research instruments according to variables:

Table 1. Grid of Infrastructure Management Instruments

Number	Dimensions	Indicator	Statement Item
1	Planning	Teacher involvement in planning infrastructure	1,2,3,4,5
2	Procurement	Transparency and efficiency in procurement of facilities and infrastructure	6,7,8,9
3	Utilization	Utilization of infrastructure in learning activities	10,11,12,13,14,15,16,17,18,19
4	Maintenance	Scheduled infrastructure selection program	20,21,22,23,24
5	Evaluation	Periodic evaluation of the condition of infrastructure facilities	25,26,27,28,29,30

Table 2. Information System Instrument Grid

Number	Dimensions	Indicator	Statement Item
1	Availability	Availability of Information Systems to support learning	1,2,3,4,5,6,7
2	Accessibility	Ease of access to information systems by teachers	8,9,10,11
3	Utilization	Use of information systems in learning planning and evaluation	12,13,14,15,16,17,18,19,20,21,22
4	Training	Training in the use of information systems for teachers	23,24,25,26
5	Technical Support	Technical support in the use of information systems	27,28,29,30

Table 3. Grid of Teacher Learning Innovation Instruments

Number	Dimensions	Indicator	Statement Item
1	Creativity	Development of creative learning methods	1,2,3,4,5,6,7,8,9,10
2	Use of ICT	Integration of information and communication technology in learning	11,12,13,14,15,16,17
3	Collaboration	Collaboration with colleagues in developing learning	18,19,20,21,22
4	Self Evaluation	Reflection and evaluation of learning practices	23,24,25,26
5	Professional Development	Participation in training or workshops to improve competency	27,28,29,30

Before the instrument was distributed to the research sample, the research instrument was first tested for validity using product moment correlation with the results of the instrument on the 3 variables being declared valid and reliability using the Cronbach's Alpha coefficient, with the results $\alpha > 0.361$, indicating the reliability of the instrument. Reliability and validity tests are conducted to ensure that measurement results are consistent. The data analysis techniques used in this study include: 1) Analysis prerequisite tests consisting of normality tests, multicollinearity tests, and heteroscedasticity tests, 2) Multiple regression analysis to determine the influence of infrastructure management (X1) and information systems (X2) on teacher learning innovation (Y) consisting of partial tests and simultaneous tests. Data analysis was carried out using the SPSS version 26 program to support accurate calculations.

C. Result and Discussion

Results

Each research variable is measured through 30 statement items covering five to six indicators. The data resulting from filling out the research instrument was processed using the SPSS program. The following are the results of the descriptive analysis for each variable:

Table 4. Statistical Description of Infrastructure Management Variables (X1)

Descriptive Statistics

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Infrastructure Management	88	84	66	150	10450	118.75	1.708	16.021	256.672
Valid N (listwise)	88								

Table 5. Statistical Description of Information System Variables (X2)

Descriptive Statistics

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Information Systems	88	82	68	150	9637	109.51	1.854	17.397	302.644
Valid N (listwise)	88								

Table 6. Statistical Description of Teacher Learning Innovation Variable (Y)

Descriptive Statistics

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Teacher Learning Innovation	88	69	81	150	11015	125.17	1.864	17.484	305.706
Valid N (listwise)	88								

The results of the descriptive analysis show that variable X1, namely school infrastructure management, has a maximum value of 150 and a minimum value of 66 and is in the high category with an average score of 3.96, while variable X2, namely the school information system, has a maximum value of 150 and a minimum value of 68 and is in the medium category with an average score of 3.65. Then, variable Y, namely teacher learning innovation, obtained a maximum score of 150 and a minimum score of 81 and an average score of 4.17 which is included in the high category.

Before conducting the hypothesis test, the data was first subjected to prerequisite analysis, normality test, multicollinearity test, and heteroscedasticity test. By performing a data normality test, we can determine whether the sample taken represents the entire population. Normality test is a step used to test whether the collected data follows a normal distribution or not (Isnaini et al., 2025). The Kolmogorov-Smirnov test was used to ensure normal distribution. The testing criteria using the Kolmogorov-Smirnov or Lilliefors test are: A normal distribution can be said if: a) Significant value or probability value ≥ α (0.05), then the data is declared to be normally distributed, b) Significant value or probability value < α (0.05), then the data is stated to be not normally distributed.

Table 7. Normality Test

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		88
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	13.22218410
Most Extreme Differences	Absolute	.086
	Positive	.060
	Negative	-.086
Test Statistic		.086
Asymp. Sig. (2-tailed)		.145[c]
a. Test distribution is Normal.		
b. Calculated from data.		
c. Lilliefors Significance Correction.		

Based on the table above, the calculations carried out using SPSS with the Kolmogorov-Smirnov test produced a significance level of 0.145. Therefore, the significance level of 0.145 > 0.05 indicates that the data is normally distributed. The next prerequisite analysis is the multicollinearity test which aims to determine whether there is a relationship between the independent variables in the regression model. Because there is concern that the research data used is not well distributed, this test is used (Hati & Aryati, 2022). Multicollinearity test using Variance Inflation Factor (VIF) with the following criteria: If the tolerance value > 0.10 and VIF < 10, it can be concluded that there is no multicollinearity.

Table 8. Multicollinearity Test

Coefficients[a]			
		Collinearity Statistics	
Model		Tolerance	VIF
1	Infrastructure Management	.481	2.077
	Information Systems	.481	2.077
a. Dependent Variable: Teacher Learning Innovation			

Based on the calculation results using SPSS, the tolerance value obtained was 0.481 > 0.10 and the VIF value was 2.077 < 10, so it can be stated that there is no multicollinearity between the independent variables in this regression model. Since regression analysis is very important for data, we need to know whether there is heteroscedasticity or not, and how to find out (Raden & Lampung, 2017). Then for the heteroscedasticity test, from the calculations obtained it can be stated that the data does not have a particular pattern and the pattern is spread above and below the zero point on the Y axis, so the data does not experience heteroscedasticity problems.

To test the hypothesis, multiple regression analysis was used. It is used to determine the strength of the relationship between the independent and dependent variables and the direction of the relationship between the two. Based on the calculation results using the SPSS program, the constant value of the regression equation α is 42.871 and the coefficient value of the independent variable b1 is 0.283 and b2 is 0.444, so the regression equation is obtained as follows:

$$Y = a + b1x1 + b2x2$$
$$= 42{,}871 + 0{,}283x1 + 0{,}444x2$$

This means that every one unit increase in the infrastructure management and information systems scores will increase teacher learning innovation by 0.283 and 0.444, respectively.

1. Partial Test

The criteria for partial hypothesis testing are as follows: 1) If the probability value (Significant) < 0.05 then H0 is rejected, and 2) If the probability value (Significant) > 0.05 then H0 is accepted.

Table 9. Partial Test

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1(Constant)	42.871	10.906		3.931	.000		
Infrastructure Management	.283	.129	.260	2.195	.031	.481	2.077
Information Systems	.444	.119	.442	3.740	.000	.481	2.077

a. Dependent Variable: Teacher Learning Innovation

Based on the table above, it is known that the significant value of the infrastructure management variable (X1) is 0.031 < 0.05 so that H0 is rejected, which means there is a significant influence between infrastructure management and teacher learning innovation. And the significant value of the information system variable is 0.000 < 0.05 so that H0 is rejected, which means there is a significant influence between the information system and teacher learning innovation.

2. Simultaneous Test

The criteria for simultaneous hypothesis testing are as follows: 1) If the probability value (Significant) < 0.05 then H0 is rejected, and 2) If the probability value (Significant) > 0.05 then H0 is accepted.

Table 10. Simultaneous Test

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	11386.568	2	5693.284	31.817	.000[b]
	Residual	15209.875	85	178.940		
	Total	26596.443	87			

a. Dependent Variable: Teacher Learning Innovation
b. Predictors: (Constant), Information Systems, Infrastructure Management

Based on the table above, the F test shows the calculated F value = 31.817 and the significant value is 0.000 < 0.05, so H0 is rejected which shows that the two variables simultaneously have a significant influence on teacher learning innovation. The coefficient of determination (R^2) of 0.428 shows that 42.8% of the variation in teacher learning innovation is explained by the infrastructure management and information systems variables.

Discussion

1. The Influence of Infrastructure Management on Teacher Learning Innovation

Based on the results of the partial test above, for the first hypothesis on the infrastructure management variable (x1), a significant value of 0.031 was obtained, which states that there is a positive and significant influence between infrastructure management and teacher learning innovation. The results of this study strengthen the theory of educational management that is put forward, namely that to achieve general educational goals and specific learning goals, educational institutions must have educational facilities and infrastructure (Fauzi, 2021, p. 2). Adequate facilities, such as digital learning spaces, laboratories, and stable internet connections, provide space for teachers to be creative and develop technology-based learning.

Then, good management of facilities and infrastructure, from planning to evaluation, also really helps teachers in innovating learning. Planning the procurement of facilities and infrastructure that involves teachers will be more efficient and appropriate because it is in accordance with the learning media needed by teachers to innovate. Evaluation and repair of damaged facilities also helps teachers and students to carry out learning activities comfortably. The available infrastructure must also be inventoried and

utilized well by teachers. Managing educational facilities and infrastructure means providing professional services, making schools a pleasant place for students, and providing sufficient quality facilities and infrastructure (Ikhwan & Qomariyah, 2022). Just like the opinion that states that in order for students to feel comfortable in the teaching and learning process, the facilities and infrastructure factors must also be taken into account (Muliawati, 2022).

It is difficult for teachers to implement modern learning models such as blended learning, the use of digital media, and project-based learning if there is no facility support. A previous study by Restika Manurung, Edi Harapan, Tahrun, and Aris Suharyadi (2020) found that facility and infrastructure management, which includes planning, procurement, use, maintenance, and disposal, has been successful (Manurung et al., 2020). The results of previous findings are in accordance with the findings made by researchers, namely that good management of infrastructure will help good learning. Meanwhile, the difference is that previous research only looked at whether facility management was successful or not. Therefore, the results of this study strengthen the understanding that infrastructure management is the key to the success of learning innovation in the 21st century. With innovation in learning, it is hoped that students will receive learning well, and this will have an impact on student learning outcomes and school quality.

2. The Influence of Information Systems on Teacher Learning Innovation

Based on the partial test results above, for the second hypothesis on the Information System variable (X2), a significant value of 0.000 < 0.05 was obtained, which states that H0 is rejected. This means that the information system has a positive and significant influence on teacher learning innovation. In addition, the school information system acts as a supporting medium for digital transformation. This is in accordance with the opinion that states that one of the reasons why management information systems are very important for educational institutions is the fact that schools are in an increasingly sophisticated environment throughout the world, along with an increasingly complex and dynamic educational environment (Solechan, 2021).

In today's digital era, information systems and digital devices are interconnected (Mursyidah et al., 2023). An information system is a man-made system consisting of various subsystems or physical and non-physical components that work together to process data with the aim of producing information that is useful for various decision makers. In the management and provision of educational services, including administration, teaching, school facilities, and student services, it is very important to use a management information system known as SIMDIK (Purwaningsih, 2022).

The information system (SIMDIK) in schools includes Dapodik, SIM PKB, belajar.id accounts which consist of various kinds of online service access (google form, google doc, google drive, google meet, and so on), e-learning which can be utilized by teachers to provide enjoyable learning, BOS fund applications (ARKAS and SIPLah) which are integrated with Dapodik, the existence of Computer-Based National Assessment (ANBK), e-report cards, and e-libraries. These various applications and websites serve as information system services that can be accessed by teachers, enabling them to optimize the use of information technology in learning.

Previous research conducted by Devi Silvia Dewi, Eji Wijaya, and Evi Erfiyana (2022) also found that the Education Management Information System (SIMDIK) is quite good when using educational applications such as Edmodo, E-Raport, and Smart Board for Axioo classes to make lessons more interactive (Dewi et al., 2022). This finding is in line with the findings made by researchers that the use of a good information system will result in innovation and creativity from teachers in learning. However, there are also challenges faced in utilizing this information system, namely the lack of training in using the information system for teachers, especially senior teachers.

In addition, the lack of teacher competence in managing information systems in education is one of the challenges that must be overcome. Internet access can also be an obstacle in the use of information systems, especially schools in remote villages that cannot use digital-based information systems properly. School applications, stable internet access, ease for teachers to obtain information about learning, and the ability to continuously communicate and track student progress are some examples of information systems that are very important for teachers as time goes by.

3. The Influence of Infrastructure Management and Information Systems on Teacher Learning Innovation

Based on the results of the simultaneous test above, the two independent variables, namely Infrastructure Management (X1) and Information Systems (X2), have a positive and significant influence on the dependent variable, namely Teacher Learning Innovation (Y). This can be seen from the significance value obtained, namely 0.000 < 0.05, which states that H0 is rejected. Then, based on the calculations from the table above, the coefficient of determination value is 48.2%, which means that learning innovation carried out by teachers can be achieved through collaboration between good management of facilities and infrastructure and support from adequate information systems.

The results of previous research, "The Influence of Facilities and Infrastructure and Utilization of Information Technology in Learning on the Quality of Education in State

Junior High Schools in North Lombok Regency in 2022", conducted by Wayan Subadre, Abdul Wahab Jufri, I Wayan Karta (2023), at the University of Mataram, Indonesia. The results of the study show that infrastructure has a positive and significant effect on the quality of education ($p \leq 0.005$). Facilities and infrastructure are classified as sufficient at 69.04%, the use of information technology in learning is classified as sufficient at 68.51%, and the quality of education is classified as good at 81.04% (Subadre et al., 2023). This is also in line with the results of research conducted by Ina Nurul Inayah, Mulyawan Safwandi Nugraha, and Endin Nasrudin (2023), which found that there was a significant influence between students' learning interest on the management of facilities and infrastructure (t 3.554 and $p < 0.05$), teachers' pedagogical competence on students' learning interest (t statistic 3.934 and $p < 0.05$), and the quality of learning on students' learning interest (Inayah et al., 2023). This shows that if schools build and implement modern information systems, it will be easier for them to encourage teachers to innovate in the teaching and learning process. Student learning outcomes will improve and schools will become better. These findings show that the better the management of facilities and infrastructure and the more optimal the school information system, the higher the level of teacher learning innovation. Good planning allows for the creation of good information systems (Rusi & Febriyanto, 2021). Digitalization of school management has a significant impact on teacher performance and creativity. Because teachers are the determinants of student success during the learning process and as the determinants of quality educational output (Ngongo et al., 2023). Information systems and information technology are very important for educational activities because they can help decision making and achieve organizational goals (Triyuni & Wijaya, 2021).

The results of the data test show that, in the partial test of the first hypothesis, there is a significant value of 0.031 (0.05), which indicates that there is a significant influence between infrastructure management and teacher learning innovation at SMP Negeri Kecamatan Ilir Timur II Palembang. In the partial test of the second hypothesis, there is a significant value of 0.000 (0.05), which indicates that there is a significant influence between the information system and teacher learning innovation at SMP Negeri Kecamatan Ilir Timur II Palembang. In the simultaneous test, a significant value of 0.000 < a (0.05) was obtained, which shows that facility management and information systems influence teacher learning innovation. This is because the management of infrastructure and information systems is part of the driving factor for the creation of innovation for teachers. The findings of this study can provide an understanding of how important it is to manage good infrastructure and information systems training so that all teachers can use information systems well. In the future, it is hoped that there will be similar research related to teacher learning innovation and its supporting factors, in order to further strengthen the fact that there are many factors in teacher learning innovation.

Because the research that has been conducted has shortcomings by only using 2 existing variables.

D. Conclusions

Based on the results of research, data analysis, and discussion on the Influence of Infrastructure Management and Information Systems on Teacher Learning Innovation, several conclusions can be drawn, namely as follows:

1. There is an influence of infrastructure management on teacher learning innovation. The conclusion is that if the management of school infrastructure, which includes planning, procurement, utilization, maintenance, and inventory of facilities, is carried out better, teachers will have greater ability to develop innovative learning methods. In other words, well-planned, well-maintained, and well-utilized school facilities and infrastructure can create a positive learning environment and motivate teachers to innovate. The better the facilities and infrastructure are managed, the higher the level of teacher innovation in implementing learning.
2. There is an influence of information systems on teacher learning innovation. This shows that teachers' desire to innovate in learning is greatly driven by the use of good school information systems. Information systems can speed up teachers' work, facilitate access to educational resources, and improve the way school members communicate with each other. Some examples of information system applications include internet access, digital learning platforms, academic data, and internal school information services. By using a well-functioning educational information system, teachers can access, process, and share digital learning materials. Therefore, it is also important to provide training for teachers so that they can use information systems in learning.
3. There is a simultaneous influence between infrastructure management and information systems on teacher learning innovation. These two variables contribute 42.8% to the variation in teacher learning innovation when calculated together. Innovative learning, responsive to technology, and relevant to the demands of the 21st century, requires collaboration between school facility management and the implementation of good information systems. This conclusion shows that there are many factors that influence learning innovation. To be successful, innovation requires adequate physical facilities and well-functioning information systems. Innovative learning, responsive to technology, and relevant to the demands of the 21st century requires collaboration between school management and the implementation of good information systems. It is hoped that this discovery will contribute to the understanding of relevant agencies and school residents regarding the importance of providing training for teachers and good management of facilities and infrastructure.

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