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Regulatory and Legal Support for the Development of Digital Infrastructure in Rural Areas as a Factor in Improving the Level of Sustainable Development and Quality of Life of the Rural Population

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Abstract: Widespread problems of rural development have been the subject of scientific analysis and discussions for many years. The current debate is the result of reflections on improving the effectiveness of rural development policy and the search for new approaches to their development at the local level. They are also the result of the need not only to implement the Sustainable Development Goals more effectively but also to reduce the social and economic inequality between the village and the city, which is possible through the development of the digital infrastructure of rural areas. The purpose of the article is to identify priority areas and institutional and legal barriers to the development of digital infrastructure, the tools necessary to overcome them, and regulatory and legal support for the development of digital infrastructure in rural areas. The article identifies the advantages of digital infrastructure for the socio-economic development of rural areas, the priority level of the introduction of digital infrastructure and technologies for various sectors in the life of the rural population, institutional and legal barriers to the development of digital infrastructure of rural areas, as well as tools of regulatory support for the development of digital infrastructure of rural areas. It is concluded that the creation of the necessary regulatory framework that would stimulate the formation of digital infrastructure while protecting the interests of rural residents is the most significant of the problems of rural areas.

Keywords: sustainable development; rural areas; digital infrastructure; institutional and legal barriers; regulatory support.

JEL Classification: Q01; R11.

Introduction

The problem of transition to the information society has come to the fore (Ilkevich *et al.* 2022) among the emerging problems in the last decade. The changes taking place depend on global technological and digital development (Nakisbaev and Dugalich 2022, 132). The importance of digital infrastructure has been reinforced by the consequences of the COVID-19 pandemic, which has moved part of its activities to the virtual sphere (Borodina *et al.* 2021, 68). Equipping rural residents with digital communication skills makes it possible to reduce the distance and, thus, increase the availability of goods and services, especially public (Galizina *et al.* 2021, 420; Sovetova 2021, 105). In this context, ICT is considered an opportunity to overcome the difficulties of sustainable rural development (Chen and Wang 2020, 2). However, its use depends on the availability of digital infrastructure, the absence or poor development of which deprives rural areas of chances for development based on digital technologies or initiatives (Stovba 2020, 69; Yesmagulova *et al.* 2023, 179).

Not only digital technologies are becoming important in the local dimension, but also actions aimed at improving the general living conditions of rural residents, including at the micro level (Dubois and Sielker 2022, 1). In this context, it is necessary to provide adequate regulatory and legal support for the development of rural areas, in the presence of which it is easier for local development leaders to consider the needs and capabilities of their residents.

The need to substantiate the regulatory support for the development of the digital infrastructure of rural areas as a factor in increasing the level of sustainable development and the quality of life of the rural population determines the relevance of the topic under consideration.

1. Literature Review

The desire to have an efficient infrastructure associated with the growth of ICT has led to the emergence of the digital infrastructure concept (Khoruzhy *et al.* 2023), in which digital technologies are integrated with physical infrastructure for real-time monitoring, effective decision-making, and accelerated and improved service delivery (Yang *et al.* 2022, 178).

The term "digital infrastructure" is used in various contexts to describe socio-economic and technical conditions. Uniform, generally accepted definitions of digital infrastructure have not yet been developed at the international level. There are no specific norms and standards for its design and construction. This creates dualism and weak interpretation and slows down the development of such infrastructure (Ogie *et al.* 2017, 8). The lack of uniform standards has an ambiguous effect on the implementation of digital infrastructure projects, since the expectations of asset owners or operators of technological implementation of digital solutions may not be justified (Henningsson and Henriksen 2011, 355).

Digital infrastructure can be defined at the basic level as an interconnected network that provides digital information about the state of the system in real-time (Del Carpio *et al.* 2022, 1). This definition focuses on the ability to self-monitor a system through a combination of physical assets and digital technologies. Digital technologies are used to obtain data in this context, which is then processed, stored, and transmitted as reliable information to assist infrastructure service providers in making informed decisions regarding the management of their infrastructure assets (Fan *et al.* 2022).

K. Salemink *et al.* (2017) defines digital infrastructure as the result of combining physical infrastructure with ICT, due to which high-quality information is generated for making effective and quick decisions at a minimal cost.

Research on the development of digital infrastructure in rural areas is carried out at various territorial levels, covering entire continents (Stojanova *et al.* 2022), individual countries (Ashmore *et al.* 2017, 408), or small administrative units (Ding 2020, 33). The problems considered in them are very diverse. Thus, studies from Asia, Africa, and Latin America are most often related to energy systems, climate (Hieu and Toan 2023, 237), and sustainable agriculture (Chen 2020, 42; Li 2020, 13), while European studies address this topic mainly in the context of revitalizing local communities through improved public services and the use of new technologies (Konečny 2019, 1; Rundel *et al.* 2020, 21).

Scientific works to date indicate a great potential for the development of digital infrastructure in rural areas in many areas, for example, in mitigating the negative consequences of rural depopulation (Cowie *et al.* 2020, 169), as a factor of rural sustainability (Roberts *et al.* 2017, 355), or a tool for activating local communities (Randall *et al.* 2020, 1). Researchers (Stojanova *et al.* 2021) expect very broad social and economic effects from the development of digital infrastructure in rural areas and consider this development as a strategy that can improve the quality of life and give young generations good reasons to stay in rural areas, rather than migrate and look for their place in the city.

In our opinion, the issue of regulatory support for the development of digital infrastructure of rural areas in the scientific literature remains poorly researched despite a fairly wide range of studies devoted to the development of digital infrastructure of rural areas in general.

In this connection, the purpose of the article is to identify priority areas and institutional and legal barriers to the development of digital infrastructure, the tools necessary to overcome them, and regulatory and legal support for the development of digital infrastructure in rural areas.

2. Methods

A qualitative and quantitative approach to the study was chosen to achieve the purpose of the study.

In the course of a desk study (based on H.A. Yasavi International Kazakh-Turkish University, Higher School of Law, M. Narikbayev KAZGUU University), an analysis of scientific sources on the development of digital infrastructure in rural areas was carried out, which showed that the effectiveness of providing digital infrastructure in rural areas depends to a lesser extent from the general conditions of economic growth and development of the country and to a greater extent – on the institutional and legal environment. Therefore, institutional and legal changes can lead to improved performance.

Further, the analysis of the Internet resources of the district Akimats of the North Kazakhstan region was carried out following the purpose of the study, based on which the selection of representatives of Akimats responsible for the digitalization of rural areas was carried out.

At the first stage of the study, the study sample consisted of 68 people who were sent e-mails indicating the purpose and program of the study. Of the respondents to whom the letters were sent, 53 people agreed to participate in the study. The survey of representatives of district Akimats was carried out from September 25 to November 25, 2022. The questionnaires were sent by e-mail and included the following questions:

1. How important is each of the listed advantages of digital infrastructure for the socio-economic development of rural areas?

2. What is the priority level of digital infrastructure implementation in your area for each of the listed sectors?

3. Which of the aforementioned digital infrastructure technologies are planned to be developed as a priority over the next 2-3 years?

4. To what extent is each of the listed institutional and legal factors a barrier to the development of digital infrastructure in your area?

At the second stage, an expert survey was conducted in the form of in-depth interviews with experts from among those who took part in the first stage of the study (18 people) selected according to criteria such as work experience in local government (at least 5 years), higher legal education, participation in projects on digitalization of rural areas. The necessary tools of regulatory support for the development of digital infrastructure in rural areas were identified during in-depth interviews, followed by their ranking and determining the weight of the tool proposed by experts.

3. Results

The results of the survey of representatives of district Akimats are presented in Tables 1-4.

Table 1. How important is each of the listed advantages of digital infrastructure for the socio-economic development of rural areas? (% of the surveyed representatives of Akimats)

Sector	Important	Not important	Find it difficult to answer
Expansion of services for residents (in the field of healthcare, social security, education, transport, housing, and utilities)	98.1	1.9	-
Efficiency of the provision of administrative services	96.2	3.8	-
Economic development	94.4	5.7	1.8
Environmental sustainability	92.5	7.5	-
Improving the efficiency of the funds used	90.6	9.4	-
Improving social justice	86.8	9.4	3.8
Ensuring public safety	73.6	15.6	10.8

Table 2. The priority level of digital infrastructure implementation in the area for each of the sectors (% of the surveyed representatives of Akimats)

Sector	Priority*	Not a priority**	Find it difficult to answer
Public services	98.1	1.9	-
Healthcare	92.4	3.8	3.8
Education	90.5	5.7	3.8
Agro-industrial production	88.7	11.3	-
Ecology	83.0	13.2	3.8
Tourism and recreation	83.0	15.1	1.9
Waste management	81.1	17.0	1.9
Banking sector, finance	77.3	17.0	7.3
Housing and communal services	77.3	22.7	-
Transport	73.6	20.8	5.6
Energetics	73.6	24.5	1.9
Trading	62.3	30.2	7.5
Public safety	49.1	45.3	5.6

Note: *the sum of the answer options "main priority" and "significant priority"; **the sum of the answer options "minor priority" and "not a priority".

Table 3. Which of the aforementioned digital infrastructure technologies are planned to be developed as a priority over the next 2-3 years?* (% of the surveyed representatives of Akimats)

Technologies of the digital infrastructure of rural territories	%
Provision of public services (optimized mobile interface)	73.6
Healthcare (online medicine, personalization of treatment methods)	58.5
Education (online training, consulting, and courses)	58.5
Registration procedures (optimized mobile interface)	50.9
Ecology (monitoring of air and water quality)	49.1
Transport (mobile applications designed for various types of public transport)	47.2
Banking sector (online payment for services)	47.2
Housing and utility sector (implementation of energy-efficient measures)	39.6
Waste management (sensors for waste containers)	30.2
Trading (mobile apps)	28.3
Public safety (CCTV cameras)	11.3

Note: *It was suggested to mark all acceptable answers.

Table 4. To what extent is each of the aforementioned institutional and legal factors a barrier to the development of digital infrastructure in your area? (% of local government representatives surveyed)

	Significant barrier	Moderate barrier	Minor barrier	Not a barrier	Find it difficult to answer
Lack of a holistic policy for the introduction of digital infrastructure at the national level	56.6	30.2	9.4	3.8	0.0
Lack of investment policy stimulating the development of digital technologies	50.9	30.2	17.0	1.9	0.0
Lack of uniform (adopted at the legislative level) standards for the introduction of digital technologies (for technological expertise)	47.2	28.3	17.0	3.8	3.8
Lack of necessary legislation and Digital Infrastructure Development Strategy	43.4	37.7	11.3	7.5	0.0
Legal non-regulation of several issues related to digital technologies and their impact on the rights of citizens	41.5	34.0	17.0	3.8	3.8
Lack of assistance institutions at the State level and the level of rural areas	37.7	35.8	22.6	3.8	0.0
Lack of political will on the ground	17.0	11.3	28.3	37.7	5.7

The results of in-depth interviews to determine the tools of regulatory support for the development of digital infrastructure in rural areas are presented in Table 5.

Table 5. Tools of regulatory support for the development of digital infrastructure in rural areas

No.	Tools	Rank	Weight
1	Development and adoption of a national digital strategy	1	0.31
2	Adoption of the national plan for broadband Internet access	2	0.24
3	Development and adoption of a Digital Infrastructure Development Strategy at the level of the Akimat of the rural territory	3	0.19
4	Development of accompanying policies for the development of digital infrastructure in rural areas	4	0.13
5	Development of data management regulations	5	0.09
6	Developing and adopting a Digital Privacy and Security Strategy	6	0.04

Note: compiled by the authors based on the expert survey

4. Discussion

Other researchers have written that the issues of ensuring the continuity of the provision of vital services in the field of healthcare, social security, education, transport, housing, and utilities are becoming increasingly dependent on digital technologies (Rundel *et al.* 2020, 21). Projects to introduce digital infrastructure in rural areas should focus on their benefits for current and future generations with the potential to make rural areas more sustainable (Kashina *et al.* 2022, 2413), slow down migration outflows from rural areas (Seidakhmetova *et al.* 2022, 1993), improve the quality of life of villagers (Kornilova *et al.* 2022, 2248), and stimulate growth not only within the rural economy but also countries as a whole (Rundel *et al.* 2020, 21). Therefore, the main advantages from the standpoint of socio-economic development of rural areas, which have been identified as important and motivate local authorities to expand infrastructure digitalization initiatives, are the expansion of various services for residents, including administrative services, resource efficiency, economic development of rural areas, and achieving environmental sustainability (Table 1). The expansion of services for city residents in the field of health, education, social security, transport, and housing is the most important for 98% of the respondents.

Digitalization of the physical infrastructure of rural areas is also seen as an opportunity to accelerate economic development (Syahidun and Nawangsari 2022, 154), expand the production base (Seidakhmetova *et al.* 2022, 1993), and increase export potential (Khoruzhy *et al.* 2022, 742). In our study, 96% focused on this. The conclusions obtained by K. Salemink *et al.* (2017) were confirmed, in particular, enterprises using digital technologies to optimize work with agricultural products and their supply chains offer a wide range of opportunities to increase efficiency (Nugmanov *et al.* 2022, 268), reduce costs, and improve quality throughout the manufacturing sector.

The respondents also highly appreciated such an advantage as the efficiency of providing administrative services (94.4%). Electronic management as an element of digital infrastructure in Kazakhstan is gaining popularity and provides for the introduction of remote decision support systems, analysis, and forecasting,

provision of state and municipal services in electronic form, including through a single access point, and access to open data and various digital platforms through which citizens can participate in the management of rural areas remotely (Timoshenko *et al.* 2022).

According to the representatives of Akimats, digital solutions for improving social justice are characterized by lesser advantages for the socio-economic development of rural areas (87%). This refers to digital inclusion, improving the level of education and medical care among people with special needs.

The relevance of introducing digital solutions into everyday life can be easily understood since they provide specific opportunities, maximizing their positive impact on the population. Thus, the respondents identified the public services sector as the highest priority for the use of digital technologies – 98.1% (Table 2). In particular, the expert Dastan (9 years of experience in government agencies) assesses the situation as follows: "The provision of public services in the Republic of Kazakhstan provides for the provision of various ICT-based services due to the intensive development of digital infrastructure in the country".

The respondents identified other sectors in which digital technologies were identified as a top priority as follows: the healthcare sector – 92.5%, education – 90.6%, agro-industrial production – 88.7%, ecology, tourism, and recreation – 83% each. This choice is conditioned by many practical examples (Berdibekova *et al.* 2022, 2222). As far as the healthcare industry is concerned, telemedicine can have various types of impacts: from saving time to getting to a medical facility to reducing the overall waiting time for patients to turn up. This can both save a considerable amount of money for rural residents and improve their overall health through accelerated access to medical care.

As for the near-term perspective (Table 3), the provision of public services is one of the priority areas where digital technologies will be introduced (73.6%). The health and education sectors received the favor of 58.5% of the respondents among other areas. The top five areas where the most modern technological changes are planned include the simplification of registration procedures and the field of ecology. Less commitment to the expansion of digital technologies in the digital infrastructure of rural areas is allocated to technologies in transport, banking, housing, utilities, waste management, trade, and public safety.

The respondents identified the following among the most significant barriers to institutional and legal support: the lack of a coherent policy for the implementation of digital infrastructure at the national level (56.6% of respondents), the lack of an investment policy stimulating the development of smart technologies (50.9%), and the lack of unified standards for the implementation of smart- technologies (to conduct technological expertise) (47.2%).

43.4% of respondents paid attention to the lack of necessary legislation for the introduction of digital infrastructure. Since digital projects may contain elements that, according to the authorities, are risky, the project may face an unexpected obstacle of changing laws or regulations during its implementation, which may delay the timing of its commissioning.

Concerning the tools of regulatory support for the development of digital infrastructure in rural areas (Table 5), we consider highlighting several important theses for discussion.

The need to develop and adopt a national digital strategy is since a nationwide approach to digitalization is extremely important (Kirillova *et al.* 2022, 35). Given the strategy, rural areas will be able to respond to the demand and supply generated by the digital economy, combining various policy areas that should be aimed at expanding the ICT sector, strengthening trust in e-government, improving digital skills and education, and overcoming challenges such as data flow management. An important place in the Strategy should belong to the management of digital security risks, ensuring confidentiality and data protection. The strategy should be focused on creating positive socio-economic conditions for development and be based on strategic and tactical goals for the deployment of digital infrastructure and the introduction of digital technologies throughout the country. Its development and implementation should be based on a vision shared by both society and economic agents (reflecting public priorities). The document should be developed through broad consultations and considering the world's practical experience. Covering a wide range of issues, the strategy should form a single holistic system, including goals and tools for their implementation and monitoring their achievement.

The adoption of the National Broadband Internet Access Plan is due to the fact that an effectively formed and successfully implemented broadband policy focused on the development of social inclusion and productivity improvement can become a catalyst for expanding the digital dividends of broadband access for the economy and society. The plan should contain measures that can eliminate key barriers to the deployment of high-speed networks, as well as have the goal of overcoming the challenges associated with ensuring competition in this market and attracting investment. The National Broadband Plan is an important tool for creating a legal environment favorable for the deployment and development of digital infrastructure in rural areas. It sets the

proposed speed, the scope of service, and the scope of coverage. The Plan should contain maps of broadband coverage, including rural areas, which is important to identify current gaps and measure progress in achieving universal Internet access. It is desirable to determine the sources of investment in infrastructure projects for the development of broadband in rural areas. The following are among the first steps to the implementation of broadband access:

- reduction of administrative barriers to the deployment of digital infrastructure in rural areas by simplifying the issuance of licenses and facilitating access to physical infrastructure;
- ensuring unhindered access to the housing and communal infrastructure of rural areas;
- approval of financial support schemes: grants, loans, guarantees, fiscal incentives;
- leveling of regulatory barriers in terms of attracting investments at the initial stages of project implementation.

The development and adoption of a Digital Infrastructure Development Strategy at the level of rural Akimat will allow it to focus on its goals and resources (intellectual and financial), due to which it is possible to achieve these goals not only in the short term but also over time. This Strategy should consider the tools and mechanisms to achieve the goal, the potential of the technologies to be used, a detailed analysis of all the pros and cons, and monitoring of the market of existing business solutions in Kazakhstan on digital technologies. The strategy should be flexible and be able to adapt to changing internal or external changes, based on a clearly defined consensus vision of the future path of socio-economic development of a particular rural area. The strategy should focus on residents, since they are taxpayers, due to which the rural area is developing. It is important to define orientations: focus on specific areas of rural life support, such as education, public safety, healthcare, etc.

Digital technologies in rural areas should be inclusive and not leave a single resident out of their positive influence. In particular, the Strategy should consider the needs of vulnerable groups of the population, such as the elderly and people with special needs. The need to reach such groups is especially noticeable given their lack of skills in using such technologies.

Development of accompanying policies for the development of digital infrastructure within rural areas, for example, policies on social inclusion, education (advanced training) (Ybyraimzhanov *et al.* 2022, 507), and public procurement (introduction of mandatory independent evaluation of parameters, such as innovation, environmental friendliness, and sociality). We need modern rules – and the possibility of their application in such areas as data security, privacy, consumer protection, and cultural values. Investment-related policies (for example, taxation and trade) are important for the development of digital infrastructure in rural areas, and a link with social policy is also necessary to reduce the potential negative social and economic consequences of digital transformation.

The development of regulations on data management with the aim of non-interference in the privacy of rural residents is due to the fact that the organization of effective data collection requires the local administration to build partnerships with key organizations that generate such information. It is important to control the flow of confidential data that contains personal information, where specific pieces of data are or may be associated with personal identification information.

The development and adoption of a Digital Privacy and Security Strategy are closely related to the previous tool since the spread of digital technologies is accompanied by a change in the scale of digital security risks, which can have a significant impact on social and economic activities (Burova *et al.* 2021, 629). It is necessary to develop a reliable set of tools for responding to digital hazard incidents and managing digital risks.

Conclusion

Maximizing the potential of the digital infrastructure of rural areas will occur only given the trust of the population in combination with business and local authorities, which give priority to sustainability issues. A prerequisite for the successful implementation of digital projects in rural areas is strong political support on the ground. Local authorities should be the initiator of the implementation of such projects and lobby the interests of rural areas at different levels to participate in regional programs of state financing for the development of the digital economy.

The survey results provide an understanding of the readiness of Akimats to implement digital solutions, the obstacles standing in the way of the development of digital infrastructure in rural areas, as well as regulatory and legal measures necessary to overcome them. Therefore, it is extremely important to have progressive and effective regulatory support, with the help of which local authorities can most effectively solve the problems of rural areas, the most significant of which is the formation of digital infrastructure while protecting the interests of rural residents.

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Credit Authorship Contribution Statement

Serikbai Ydyrys: Conceptualization, Methodology, Validation, Supervision, Writing – Review and Editing. **Nazgul Ibrayeva**: Investigation, Formal Analysis, Writing – Original Draft. **Fariza Abugaliyeva**: Investigation, Formal Analysis, Writing – Review and Editing. **Mira Zhaskairat**: Project Administration, Methodology, Formal Analysis, Writing – Original Draft. **Aiman Uvaliyeva**: Data Curation, Investigation, Validation, Writing – Review and Editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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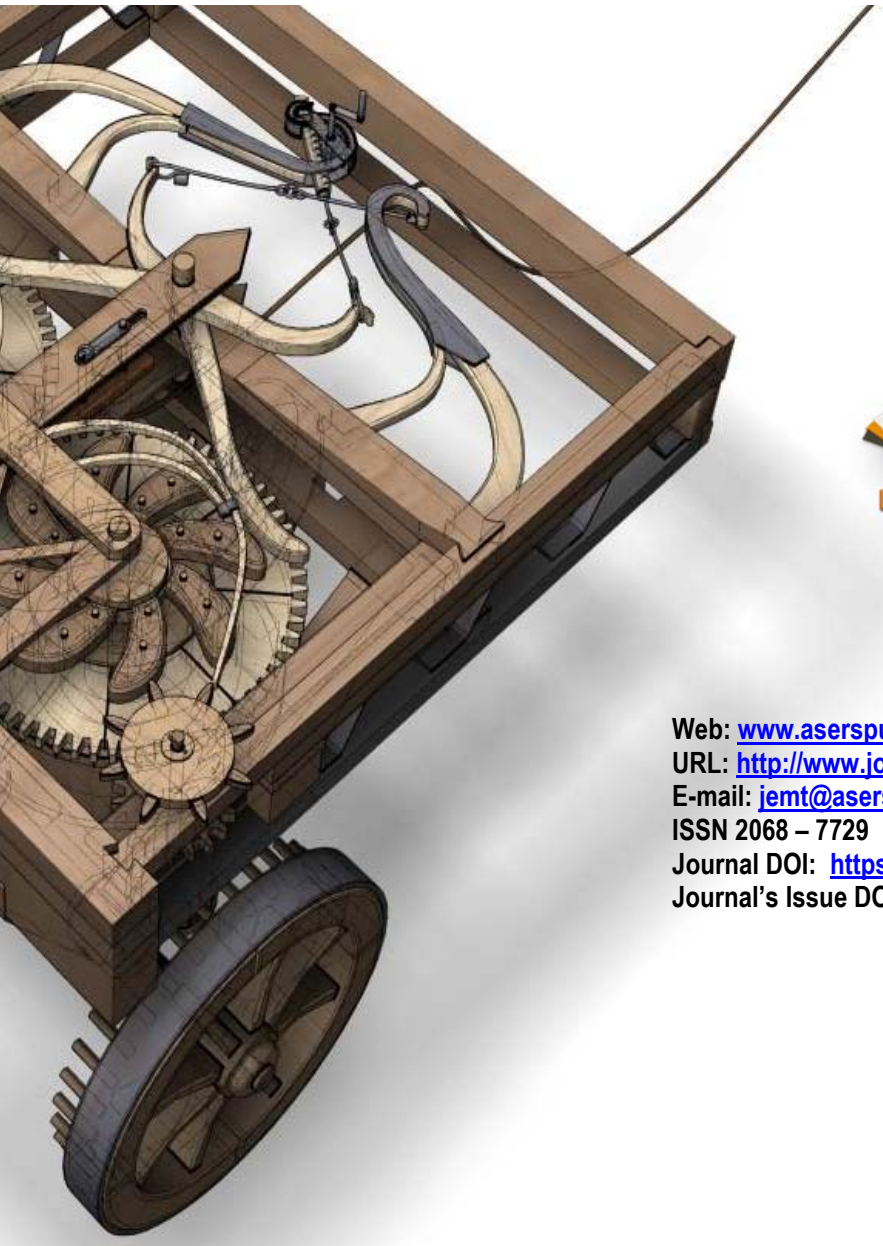

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