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Article

Data Governance in Digital Ecosystems of National Infrastructure Projects: A Literature Review in the Context of Sustainable Economic Development

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Abstract: The green modernisation of energy and utility infrastructure is delivered through large national projects involving many public and private organisations. This paper reviews the literature on programme management, data governance, digital ecosystems and public-sector data governance. The review shows that existing data governance models are designed for single organisations, while inter-organisational settings face a collective-action problem. Using Kazakhstan's national project for modernising the energy and utility sectors as a reference case, the paper argues that a federated data governance model linked to the project life cycle is a promising direction for sustainable project delivery.

Keywords: data governance; digital ecosystems; national projects; programme management; sustainable development; Kazakhstan.

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1. Introduction

Modernising energy and utility networks is a core element of the green economy. Lower losses of heat, water and electricity, higher energy efficiency and reliable services support the Sustainable Development Goals on clean water (SDG 6), affordable and clean energy (SDG 7) and sustainable cities (SDG 11) [1]. Such modernisation, however, is rarely carried out by a single organisation. It is delivered through national projects that bring together ministries, local authorities, financial institutions, technical operators and utility companies.

In Kazakhstan, the national project "Modernisation of the Energy and Utility Sectors" for 2025–2029 envisages 13,588 billion tenge of investment [2]. Its targets are expressed as data: by 2029, heat-network wear is to fall from 54% to 42%, electricity-network wear from 76% to 45%, and the share of electricity metering points with remote data transmission is to rise from 17% to 100% [2]. The project involves the Ministry of National Economy, sectoral ministries, akimats, a financial operator, a technical operator, banks and natural-monopoly utilities, which exchange data through several information systems, including an electronic project platform and a national project monitoring platform [2].

Since 2026, the Digital Code has defined digital data as a separate object of regulation [3], and the Requirements for Digital Data Management oblige public bodies and the quasi-public sector to appoint persons responsible for data, maintain data passports and catalogues and reconcile data with reference sources [4]. These rules,

however, address each organisation separately, whereas a national project is delivered across organisational boundaries. It remains unclear who is responsible for the data of the project as a whole. The aim of this paper is to review the literature in order to clarify how data governance should be organised in the ecosystem of a national infrastructure project.

2. Methodology

A narrative literature review was conducted. Sources were searched in Scopus, Web of Science, ScienceDirect, Springer Link, AIS eLibrary and Google Scholar using the keywords “data governance”, “inter-organizational data governance”, “data ecosystem”, “public sector data governance”, “programme governance” and “megaprojects”, as well as in the legal databases of Kazakhstan. Peer-reviewed articles, monographs and standards published in the last ten years were included, together with current legal acts. Works on purely technical data architecture without a governance dimension were excluded. The selected sources were grouped into four thematic streams.

3. Results

Programme management. A national project can be viewed as a programme: a group of related projects managed in a coordinated way to obtain benefits that would not be available from managing them individually; programme governance and benefits management are among its core domains [5]. Research on large projects shows that most of them exceed their budgets and schedules and deliver fewer benefits than planned, and that optimistic and unreliable information at the planning stage is one of the main causes [6]. Data governance is therefore part of programme governance rather than a purely technical task.

Data governance. Abraham, Schneider and vom Brocke define data governance as a cross-functional framework that specifies decision rights and accountabilities for data and implement it through structural mechanisms (roles and responsibilities), procedural mechanisms (policies, standards, processes) and relational mechanisms (communication and coordination) [7]. Their framework distinguishes intra-organisational and inter-organisational scope and shows that the design of data governance depends on its antecedents, such as organisational structure and regulation [7]. The data mesh approach proposes federated governance, in which a central body sets common rules while domain owners remain accountable for their own data [8]. Federated governance offers a compromise between centralised models, in which the centre does not own primary data, and decentralised models, in which data of different participants are not comparable.

Digital ecosystems. Ecosystems are characterised by participants linked through specific complementarities and coordinated without full hierarchical control [9]. Lis and Otto show that data governance mechanisms in ecosystems differ from those used within a single organisation [10]. Benfeldt, Persson and Madsen describe data governance as a collective-action problem: one participant bears the cost of data quality, while others receive the benefits, so without shared rules and incentives the quality of common data declines [11]. A national project is a typical example of such a setting: the project office coordinates ministries, operators, banks and utilities but does not manage them directly.

Public sector. Janssen et al. link data governance in the public sector to trust in data and in decisions based on them [12], and the OECD calls for a coherent approach to data across the whole public sector [13]. Studies from Kazakhstan show that e-government in the country is highly developed, but information on portals is often outdated and the level of automation remains limited [14], while open government data are positively associated with citizens’ trust in state institutions [15].

4. Discussion

The review reveals a research gap. Programme management acknowledges the central role of data but does not explain how to govern it; data governance research focuses

mainly on single organisations; and studies of ecosystems and the public sector are rarely linked to the life cycle of public projects. For green-economy infrastructure programmes, this gap translates into practical risks: inconsistent data on facilities and indicators across participants, manual reconciliation, delayed reporting and loss of data when participants change.

The literature suggests that a federated data governance model is most suitable for such projects. In this model, the project office sets common rules, reference data and reporting requirements, while each participant is accountable for its own data domain at each stage of the project, from application screening and financing to implementation and monitoring of targets. Such a model translates the organisation-level requirements of the Digital Code [3], [4] to the level of the project and can contribute to SDG targets 16.6 (effective, accountable and transparent institutions) and 17.18 (availability of high-quality, timely and reliable data) [1].

5. Conclusion

Effective data governance is a precondition for the sustainable delivery of national infrastructure projects that underpin the green transition. Existing models of data governance are designed for single organisations and do not reflect the inter-organisational nature of national projects. Further research will empirically assess data governance practice in the ecosystem of Kazakhstan's energy and utility modernisation project and develop and validate a federated data governance model linked to the project life cycle.

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